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Identification and Listing of Hazardous Waste Under RCRA, Subtitle C, Section 3001 Ignitability Characteristic (40 CFR 261.21)

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This document is one of a series providing support for regulations issued by the U.S. Environmental Protection Agency (EPA) under Subtitle C of the Resource Conservation and Recovery Act (RCRA). The regulations represent the initial effort for nationwide control of hazardous waste from point of generation, through transportation, treatment, and storage, to point of ultimate disposal.

This document explains how EPA identified ignitability as a hazardous waste characteristic.

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BACKGROUND DOCUMENT

IDENTIFICATION AND LISTING OF HAZARDOUS WASTE
UNDER RCRA, SUBTITLE C, SECTION 3001

Ignitability Characteristic
(40 CFR 261.21)

This document (ms. 1941.23) provides background information and support for EPA's hazardous waste regulations

U.S. ENVIRONMENTAL PROTECTION AGENCY
May 1980

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BACKGROUND DOCUMENT

RESOURCE CONSERVATION AND RECOVERY ACT

SUBTITLE C - IDENTIFICATION AND LISTING OF HAZARDOUS WASTE

§261.21 - Characteristic of Ignitability

May 2, 1980

U.S. ENVIRONMENTAL PROTECTION AGENCY

OFFICE OF SOLID WASTE

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ABBREVIATIONS

ASTM	American Society of Testing Materials
CFR	Code of Federal Regulations
CPSC	U.S. Consumer Product Safety Commission
FR	Federal Register
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
IMCO	Inter-Government Maritime Consultative Organization
IOTTSG	International Oil Tanker Terminal Safety Guide
NFPA	National Fire Protection Agency
RCRA	Resource Conservation and Recovery Act
°C	degrees Celcious
°F	degrees Fahrenheit
≤	less than or equal to
≥	greater than or equal to
>	greater than
FP	flash point
%	percent
psia	pounds per square inch absolute
(n)	noun
(adj)	adjective
m	meters
s	seconds
min	minute
in	inch
kpa	kilo Pascal

Ignitability Characterization Background Document

I. Introduction

Subtitle C of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976 creates a comprehensive "cradle-to-grave" management control system for the disposal of hazardous waste designed to protect the public health and the environment from the improper disposal of such waste. Section 3001 of that Subtitle requires EPA to identify the characteristics of and list hazardous waste. Wastes identified or listed as hazardous will be included in the management control system created by Sections 3002-3006 and 3010. Wastes not identified or listed will be subject to the requirements for non-hazardous waste imposed by the States under Subtitle D. The Agency has determined that ignitability is a hazardous characteristic because improperly managed ignitable wastes pose a substantial present or potential danger to human health and the environment. The purpose of this document is to explain the Agency's definition of ignitable waste, to discuss the comments received on the proposed definition of ignitability (43 FR 58955-58956, December 18, 1978) and the changes subsequently made.

II. Proposed Regulation

Ignitable Waste.

(1) Definition - A solid waste is a hazardous waste if a representative sample of the waste:

- (i) Is a liquid and has a flash point less than 60°C (140°F) determined by the method cited below or an equivalent method, or
- (ii) Is not a liquid and is liable to cause fires through friction, absorption of moisture, spontaneous chemical changes, or retained heat from manufacturing or processing, or when ignited burns so vigorously and persistently as to create a hazard during its management, or
- (iii) Is an ignitable compressed gas as defined in 49 CFR 173.300(b), or
- (iv) Is an oxidizer as defined in 49 CFR 173.151.

(2) Identification method

- (i) Flash point of liquids shall be determined by a Pensky-Martens Closed Cup Tester, using the protocol specified in ASTM standard D-93-72, or the Setaflash Closed Tester using the protocol specified in ASTM standard D-3278-73 or any other equivalent method as defined in this Subpart.
- (ii) Ignitable gases shall be determined by the methods described in 49 CFR 173.300.

III. RATIONALE FOR THE PROPOSED REGULATION

A. Rationale for Proposing an Ignitable Characteristic

Ignitability* was chosen as a characteristic of hazardous waste because ignitable wastes pose a substantial present or potential danger to human health and the environment if improperly managed. Such wastes can cause fires which directly damage the environment by heat and smoke production or indirectly damage the environment by providing a vector through which other hazardous wastes can be dispersed. An example of the latter would be the creation of convection currents that transport toxic particulates. Ignitable wastes may also result in fires which cause otherwise benign wastes to become hazardous. An example of this would be the production of noxious fumes from the burning of plastic waste. Past routine management of ignitable wastes has resulted in death and injury to persons and damage to property. Appendix I lists and discusses some of these damage incidents.

In acknowledgment of the dangers associated with ignitable wastes, Congress designated flammability (ignitability) as a potential hazardous characteristic. At page 25 of the House Report**, the House Committee stated as follows:

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* EPA has used the term "ignitability" to avoid confusion with DOT's use of the term "flammability" in its regulations. EPA's definition of ignitability is synonymous with ASTM's definition of flammability. ASTM defines flammability as the capability of a substance/waste to undergo a rapid exothermic oxidation process accompanied by continuous evolution of heat and usually light under normal ambient conditions.

**Report of the Committee on Interstate and Foreign Commerce, U.S. House of Representatives (H.R. 14496)

> ". . ., the Committee's intention is that EPA, in the development of the characteristics of a hazardous waste take into consideration the toxicity of the waste, its persistence and degrability in nature, its potential for accumulation into tissue and other related factors, such as _flammability_, corrosiveness or other hazardous characteristics." (emphasis added).

In further acknowledgment of the dangers posed by ignitable wastes, several States regulate or set guidelines for the management of ignitable wastes and public or private organizations often publish suggestions for their safe management. Appendix II lists some of these regulations, guidelines and suggestions. For a detailed discussion on the criteria for determining characteristics, see appropriate background document.

B. Rationale for proposed definition

In formulating the ignitability characteristic, the Agency has sought to identify and employ an indicator or measure of ignitability which best models the hazards associated with ignitable wastes. Unfortunately, no single indicator adequately models the hazards presented by all of the physical states (gas, liquid, semi-solid, or solid) in which ignitable wastes occur. Consequently, the Agency has had to treat the different physical states of ignitable wastes separately in constructing its definition of ignitability. This separate treatment is discussed below.

1. Ignitable Liquids

There are several established measures or indicators of the ignitability of a liquid waste*; for example, flash point, fire point, autoignition, etc. These measures and other terms related to fire phenomenon measurement are presented and defined in Appendix III. The most attractive of these indicators of ignitability is the flash point of the waste. Flash point is defined as the lowest temperature, corrected to a pressure of 101.3 K Pa (1013 millibars), of a substance at which application of an ignition source causes the vapor above the substance to ignite under specified conditions of test[1]. The Agency believes that flash point best models the hazards associated with the disposal of ignitable liquid waste streams. Vapor/air mixtures above the liquid waste can be readily ignited by ignition sources that typically are encountered in the transportation, storage, and disposal of such wastes. Such ignition sources include the hot exhaust systems of compaction equipment and trucks used in landfills and for hauling wastes; electrical sparks from the ignition systems of such equipment; electrical sparks from pump motors and other electrical devices; and sparks from friction and lighted cigarettes. Internal temperatures can elevate the temperatures of wastes past ambient temperatures. Such internal heat sources include thermal energy resulting from such things as the heat of decomposition of organic waste or the absorbed heat of the sun on the sometimes dark and broken surface of the landfill. Once ignited, liquid wastes with low flash points can cause fires which result in the damage outlined above. All government agencies and professional associations contacted by the Agency during the early development of these regulations recognized flash point as the primary indicator of the fire hazard of liquids. The primary reasons given for this recommendation were the general industrial acceptance of flash point test standards, the inexpensiveness of flash point testing, and the many years of data compilation. As Appendix II discloses, states and public and private organizations which have promulgated regulations and guidelines regarding ignitable liquids have almost invariably used flash point as the barometer of ignitability.

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*Liquids are defined by the limitation of test standards proposed later in this document.

Another possible indicator of ignitability is the fire point of the waste. Fire point is defined as the minimum temperature to which a material must be heated in an open vessel before the substance will sustain combustion for a specified period of time after ignition by an external source[1]. Fire point differs from flash point largely in that it measures the capacity of a substance to sustain combustion when ignited by an external source rather than just the capacity of a substance to flash. The two are thus closely related and the fire point of a substance is generally only a few degrees higher than the flash point. Although fire point models the hazards which accompany the ignition of ignitable liquid waste streams, the Agency has determined that flash point is the better indicator of ignitability. This is because of the small difference between flash point and fire point, the widespread acceptance of flash point by the regulated community, and the dangers associated with liquids that flash.

Another possible indicator of ignitability is the autoignition temperature of the waste. Autoignition is the spontaneous ignition of a material which occurs not as a result of an external ignition source, but as a result of heat liberation from an exothermic reaction occurring in the material[1]. Autoignition temperature is the temperature at which this spontaneous ignition takes place. Autoignition temperatures tend to be much higher than flash point temperatures--generally several hundred degrees higher, as Table 1 illustrates. Consequently, it is very unlikely that wastes would be exposed during their management to energy sources of the magnitude necessary to heat them to their autoignition point. The Agency has rejected autoignition temperatures as a suitable indicator of ignitability because autoignition temperature fails to model the particular hazard the Agency wishes to minimize -- i.e. the external ignition of volatilized liquid wastes. To the extent the autoignition of liquid wastes does pose a hazard, this hazard is likely to be taken care of by the flash point limits.

While most States, agencies, and organizations that define ignitability use flash point as their criterion, there exists

Table 1

Comparison of Flash Point and Autoignition Temperatures

Substance	Flash Point* of °F (°C)	Autoignition* of °F (°C)
Acetaldehyde	36 (2.2)	365 (185)
Acetic Acid (Glacial)	109 (42.8)	800 (426.7)
Allyl Alcohol	70 (21.1)	713 (378.3)
Camphor	150 (65.6)	871 (466.1)
Ethyl Alcohol	55 (12.8)	793 (422.8)
Fuel Oil #1	100 (37.8)	444 (228.9)

*NFPA, Fire Protection Handbook, 12th Edition, Chapter IX, Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids, Table 6-126.

no consensus on what the limit should be. For example, the Department of Transportation (DOT) defines substances with flash points below 37.9°C (100°F) as flammable and flash points at or above 37.8°C but less than 93.3°C(200°F) as combustible[2]. A number of organizations, responding to the Department of Transportation's effort to standardize its flash point limits, have followed suit. See Appendix II. Ohio, on the other hand, defines liquids with flash points less than 79.4°C (175°F) as flammable and does not recognize the combustible category at all[3]. Similiarly, the National Fire Protection Association (NFPA) has erected a classification system which defines liquids with flash points below 37.8°C (100°F) as Class I (flammable) liquids, liquids with flash points at or above 37.8°C and below 60°C(140°F) as Class II (combustible) liquids and liquids with flash points above 60°C as Class III liquids.

There are persuasive reasons for concluding that these various flash point limits and classification schemes either do not adequately take into account the hazards accompanying the transportation, storage, and disposal of ignitable liquid wastes or are inappropriate for other reasons. For instance, the Department of Transportation's flash point limit of 37.8°C(100°F) for flammable substances appears to have been chosen for the purpose of keeping all of the fuel oils regulated by DOT in the combustible category (i.e., to avoid classifying some fuel oils as flammable and others as combustible). This flash point limit was apparently not designed to take into account all of the heat sources to which ignitable liquids are exposed during transit, storage, and ultimate disposal. J. M. Kuchta, et al., in an early DOT study[4] recommended as follows:

> It is recommended that a flammable liquid be defined as one with a flash point below 140°F, as determined in a Tag Closed Cup, and having a vapor pressure not exceeding 40 psia at 100°F. The 140° break point is suggested because ambient temperatures of this order can be encountered during shipment, particularly in hot climates, this break point is also consistent with the NFPA and IMCO classification systems and that proposed by IOTTSG.

Similiarly, the classification schemes adopted by NFPA and DOT are inappropriate because they would force EPA to adopt a degree of hazard approach to the identification of hazardous waste. EPA's approach has been to classify wastes as either hazardous or not and to rely on the waste management regulations promulgated under Section 3004 and 3005 to inject any needed flexibility into the waste management requirements*.

In selecting a flash point limit for controlling ignitable liquids, the logical choice would be to use that temperature to which wastes are capable of being subjected during routine management. After careful study, the Agency has discovered that liquid wastes are exposed to temperatures of up to 140° in the routine handling of such wastes. As noted by J. M. Kuchta in the DOT study referenced above[4], this upper temperature can occur inside storage tanks, storage containers and transportation tank trailers on hot sunny days. As indicated by the studies referenced in Table 2, this temperature is also frequently encountered in landfill environments. Accordingly, the Agency has elected to use a flash point of 60°C (140°F) as the regulatory limit for defining whether a liquid waste is an ignitable hazardous waste. To use a lower flash point limit would exclude from regulatory coverage many liquid wastes which could, in fact, present a hazard under typical conditions encountered in liquid waste management, that is fires that result from the ignition of these wastes. This flash point limit will include all those liquid wastes which would fall within Class I and Class II of NFPA's classification scheme.

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*One of those who advocated setting up a classification system for defining ignitability was Mr. Harry A. Wray of the American Society for Testing Materials. He advocated a classification system based on a combination of NFPA Code, DOT[2], DOL[5] regulations.

2. Ignitable Solids

Solid materials typically do not volatilize as liquid materials since most solids have lower vapor pressures than do liquids. Consequently, solid wastes rarely have low flash points, that is those less than 60°C (140°F). The hazards that attend the management of liquid wastes and that are modeled by flash point thus do not attend solid wastes. Even if this were not the case, it would be difficult to construct a

Table 2

Typical Landfill Temperatures

Study/References	Temperature/Conditions	Remarks
1. Survival of Fecal Coliforms and Fecal Streptococci in a sanitary landfill[6].	120°F (48.8°C) to 140°F during the first week in the middle-section of the landfill at 2 to 6 foot depths (temperatures were 10 to 15 degrees lower in the periphery.	Landfilling conditions models nicely the cell of many sanitary land disposal sites.
2. Boone County Field Site Interim Report, Test Cells 2A, 2C and 2D[7].	Peak temperature recorded was 51.1°C (124°F)	Highest readings were 4 to 6 days after refuse placement.
3. Sonoma County Solid Waste Stabilization Study[8].	Peak temperature recorded was 43.9°C (111°F)	The season temperature variations for this study shown an ambient range of almost 20°C (78°F) over the annual cycle. In general, there is an apparent temperature response of the upper several feet of the landfill.
4. Management of Gas and Leachate in Landfills[9].	Ambient temperatures during test cell studies peaked at 35°C (95°F) for air and 59°C (138.2°F) for refuse.	
5. Decomposition of Landfills[10]	(1) 71°C (159.8°F) at 0.9m deep. (2) 40°C (104°F) at 3.3m deep.	(1) Aerobic condition near the surface of landfills resulting in relatively high temperatures. (2) Anaerobic conditions prevail at deeper layers of the landfill, thus lower temperatures.

Table 2 (cont.)

Study/Reference	Temperature/Conditions	Remarks
6. Water Pollution Potential of Spent Oil Shale Residues[20].	Surface temperatures of 77°C (170.6°F) have been measured in small experimental plots due to absorption of solar energy.	Case spent shales were studies in these plots.
7. Evaluation of Emission Control Criteria for Hazardous Waste Management Facilities[26].		Study recommends that materials with flash points below 62.5°C (150°F) need special disposal considerations.

reproducible flash point testing procedure for solids. Solids are usually poorer conductors of heat than liquids, and vary widely in thermal transport properties. When a solid is heated, heat build-up is intense at the energy source, due to poor conductance. The flash point of a given solid will therefore depend on the duration of heating and the rate of change of heating. For example, if a solid were heated slowly it would register a lower flash point than if it were heated quickly, due to the inability of solids to quickly reach thermal equilibrium. In light of the above, EPA has concluded that flash point is not an appropriate indicator of the hazardousness of solid ignitable wastes.

While solid wastes generally do not present a hazard by virtue of their ability to volatize, some solid wastes do present a hazard by virtue of their capacity to ignite and burn as a result of friction, moisture absorption, or spontaneous reaction under normal temperatures and pressures encountered in waste management. Such wastes, which are closely akin to reactive wastes, can cause direct injury to workers or other persons as a result of fire, induced explosions, or induced generation of toxic gases at almost any point in the waste management process: transportation, storage, treatment or disposal. EPA knows of no available, standardized test methods for measuring the hazards associated with friction, moisture absorption, or spontaneous reaction of solid wastes. J.M. Kuchta and A.F. Smith of the

Bureau of Mines in a report that was done for the Department of Transportation[11] established test methods for use in classifying flammable solids. However two independent contractors assigned the work of evaluating the proposed test protocols determined that these test methods were not reproducible[12,13,14]. These test methods are furthermore quite complex, require special equipment, and are not widely used. In the absence of available test methods which can be used to quantitatively define the ignitability hazard presented by waste, EPA proposed a narrative definition similar to the one used by DOT in its Hazardous Materials Regulation (49 CFR 173.150; see Appendix VII). The proposed narrative definition was as follows:

> a solid waste is a hazardous waste if a representative sample of the waste .... is liable to cause fires through friction, absorption of moisture, spontaneous chemical change or retained heat from manufacturing or processing, or when ignited burns so vigorously and persistently as to create a hazard during its management.

EPA believes that this definition (as amended in accordance with the discussion below), will be sufficiently specific to enable generators to determine, through their knowledge about the waste or its constituents or through their prior observations of and experience with similar types of wastes, whether their solid waste is ignitable. The waste property defined by this definition is that of thermal instability. Solid wastes having this property will, like reactive wastes, be easily detectable by the generator because experiences with handling the waste or similar wastes will most likely have revealed this instability. Therefore, until the Agency, DOT, or others are able to develop a more quantified definition of ignitable solids, with associated test methods, EPA believes it is justified in using this narrative definition.

3. Ignitable Compressed Cases

Containers of ignitable compressed gases are occasionally, but not frequently, discarded as wastes. The containers are subject to mechanical rupture during transportation, storage and disposal. In addition, they are subject to corrosion and eventual leaking in long-term storage and land disposal. If ruptured or corroded, the escaping gas could be ignited by electrical sparks or other ignition sources, in the same fashion as ignitable liquids. The fires resulting from such ignitions threaten injury to workers, firemen, and other exposed persons. DOT has defined compressed gases in its Hazardous Materials Regulations (49 CFR 173.300). This definition sufficiently embraces the compressed gases which are likely to be hazardous under conditions normally encountered in the management of such wastes. Consequently, EPA has adopted the DOT definition.

4. Ignitable Oxidizers

EPA considered including in its ignitability characteristic wastes which were not easily ignited but which, once ignited, would burn and contribute to an ongoing fire. The Agency has declined to classify such combustible wastes as ignitable in recognition of the fact that virtually all nonmetallic wastes, including paper, waste wood products and other organic wastes might display this particular feature. EPA believes that the waste management requirements imposed under both Subtitle C and D of the Act, (which control open burning and other conditions resulting in strong ignition sources) will be sufficient to protect against any hazards associated with such combustible wastes.

Notwithstanding the foregoing, EPA has determined that strong oxidizing wastes should be classified as hazardous wastes. Once combustion is initiated, these wastes would promote and sustain very aggressive burning or fuming and, therefore, would significantly increase the peril to workers, firemen, and other exposed persons. EPA knows of no widely available, simple, standardized test methods for measuring and defining strong oxidizing wastes. In a DOT funded study to develop a suitable test method,[15] the Bureau of Mines proposed an apparatus for testing oxidizers which is based on the burning rate of a red oak sawdust/oxidizer mixture. In three later studies [12,13,14], two independent contractors were assigned the task of evaluating separately the Bureau of Mines apparatus and classification system. These contractors concluded that the reproducibility of the test protocol was very poor. Consequently, EPA proposed using the same narrative definition used by DOT in its Hazardous Materials Regulations (49 CFR 173.151). EPA believes this definition is sufficiently descriptive to enable waste generators to ascertain whether they have an oxidizing waste.

C. Rationale for Proposed Test Methods

1. Ignitable Liquid Test Protocols

There are two basic methods used for testing the flash point of liquids: open and closed cup testers. Both methods require that the sample be placed in a sample cup and heated at a slow and constant rate. In a closed cup tester, the test flame is inserted into a vapor/air mixture within the closed cup and over the liquid, whereas in an open cup, the test flame is passed over the vapor/air mixture just above the liquid. While liquids will flash at the same concentration of vapor and air in both cups they will flash at a lower temperature in a closed cup. This is because, in the open cup, the temperature must be raised to a greater degree to achieve the same concentration of vapor and air as in the closed cup since the vapor above the liquid is confined in a closed cup but is allowed to diffuse into the atmosphere in an open cup.

The Agency considers the closed cup tester to be more suitable for testing the flash points of liquids. This is because the closed cup tester better replicates the most dangerous type of ignitable liquid waste situation -- that is, the situation where vapor from ignitable wastes collects in a closed space, such as in a storage drum, warehouse, etc. A recent EPA report which lists a large number of accidents involving landfill gas shows that volatile gases emanating from landfills can accumulate in buildings, pipes, excavations, manholes and soil up to 1000 feet from the fill area[16]. In one such accident, gas emerging from a landfill collected in a barn and caused injury when it exploded[16]. The closed cup tester is a more conservative representation of the hazard presented by such confinement of the vapor from volatilized liquids. In addition, the closed cup tester is not as subject to interference from air currents and gives more reproducible results.

Closed cup testers come equipped with different features. There are two types of temperature baths available. (A temperature bath is the heat transport media between the cup of the tester and the heating element). Since the purpose of these temperature baths is to insure uniform temperature around the entire sample, a liquid bath is superior to an air bath because liquids transport heat better than air. Also, there are two types of heating elements; electric and gas. It makes little difference in the test results whether the apparatus has a gas or electric burner. Both are equally accurate at the low temperatures of concern. An optional feature for closed cup testers is a mixing device or stirrer. The stirrer can prevent interference in the operation of the test which results when test samples are very viscous, tend to skin over, tend to stratify, or contain suspended solids. If, for instance, a sludge is stratified, the upper layers will inhibit the volatilation of the lower layers. The evaporation of the lower layers will occur at the normal rate only when the lower layers are in direct contact with the atmosphere. A mixing device cures this problem. Since the most prevalent forms of waste streams destined for land disposal are sludges and semi-solids, EPA believes that closed cup testers should be equipped with a mixing device.

The closed cup tester which satisfies the above requirements is the Pensky-Martens Closed Cup Tester. Table 3 compares this tester with the Tag Closed Cup tester and demonstrates available options. Table 4-ASTM Specifications and Measured Performance for Several Flash Point Testers - compares data on repeatability and reproducibility[4]. As shown in this table, there are two testers that are fairly reproducible, The Taliague and the Pensky-Martens Closed Cup Testers.

J. Kuchta in his report to DOT[4] made the following recommendations:

> According to the available data in the literature, the Tag closed cup is suitable for determining flash points of liquids over a temperature range from about 220°F down to at least 0°F. Although it is currently recommended for determinations up to only 174°F, ASTM Committee (D-2 and E-27) are presently proposing that the maximum temperature be increased to 200° or 220 °F for use with liquids having a viscosity of 4 centipoise (100°F) or less. For liquids of higher viscosity or higher flash points, the Pensky-Martens closed cup is recommended. However, one can also extend the use of the Tag tester to the higher viscosity liquids by employing a lower heating rate than presently specified. A heating rate

Table 3 - Comparison of Flash Point Tester Types

Type	Sample Cup	Stirrer	Bath	Type of Temperature Control
Pensky-Martens (Fisher)	Closed	No	Air	Electric
Pensky-Martens (Fisher)	Closed	Yes	Air	Electric
Tagliague (Fisher)	Closed	No	Liquid	Electric
Pensky-Martens (Fisher)	Closed	No	Air	Gas
Pensky-Martens (Fisher)	Closed	Yes	Air	Gas

TABLE 4 - ASTM Specifications and Measured
Performance for Several Flash Point Testers

Tester	ASTM Designation	Temp. Range °F	Heating Rate °F/min	Repeatability** °F	Reproducibility
Tagliaque	D 56-64	55	2	2	6
Closed Cup		15-175	2	2	4
Pensky-Martens	D 93-66	<220*	9-11	4	6
Closed Cup		>220†	9-11	10	15

[4] Kuchta, J.M. and D. Burgess. Recommendations of Flash Point Method for Evaluation of Flammability Hazard in the Transportation of Flammable Liquids, Safety Research Center, Bureau of Mines, Report #54131, April 20, 1970.

*Less than
†Greater than

** Duplicate results by the same operator

*** Results submitted by each of two laboratories

> of less than 0.5°F/min. or a maximum temperature difference of 5°F between the bath and sample have been found suitable for extending the applicability of this tester to thicker fuels and other highly viscous materials.

These recommendations are in order, except that using the Tag tester for very viscous materials is not standard practice. Agitation of the liquid is necessary if the liquid has a vicosity of 45 S.U.S.* or more at 37.8°C (100°F)[4], or if it contains suspended solids or has a tendency to form a surface film during testing. Consequently, the Pensky-Martens has been recommended as the tester for ignitable liquids because of the incorporation of a stirring device to handle the testing procedure of sludges and slurries.

Another possible tester is the Setaflash tester, which is an electronic apparatus. The Setaflash tester was investigated and found to be a good means of flash point determination, and thus has also been included in the proposed regulations as a means for determining the flash point of ignitable wastes. The Setaflash closed cup tester determines flash points between 0 and 110°C (32 and 230°F) having a viscosity lower than 150 stokes at 25°C (77°F)†. For liquids at or below 45 S.U.S. at 100°F, the average of the duplicate results obtained by the same operator on different days should be considered suspect if they differ by more than 1.7°C (3°F); each of two laboratories should not differ by 3.3°C(6°F)†. For viscous liquids above 45 S.U.S. at 37.8°C (100°F) or liquids with dispersed solids, duplicate results obtained by each of two laboratories should not differ by more than 5°C (9°F)† Because this tester is relatively new, EPA asked one ASTM Committee for recommendations regarding it. The opinions were very positive from both government and industrial members. It seems the tester can save a laboratory a substantial amount of money if repetitive flash point determinations are needed, although the data for such savings was not attainable.

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* S.U.S. means Saybolt Universal Seconds as determined by the Standard Method for Saybolt Viscosity (ASTM D88-56 and may be determined by the Use of the S.U.S. conversion tables specified in ASTM test D2161-66 following determination of viscosity in accordance with the procedures specified in the Standard Method for Transparent and Opague Liquids (ASTM D445-65).

† Data on Setaflash available ASTM D3278-73.

2. Ignitable Compressed Gas

Since EPA has adopted the DOT definition for ignitable compressed gasses, the test method specified in the DOT regulations has also been adopted. The Agency assumes that this test protocol has undergone the required testing to determine its accuracy, reproducibility, detection limits, etc.

IV. Comments Received on the Proposed Characteristic and the Agency's Response to These Comments

The Agency received over one-hundred comment letters and oral statements* addressing ignitability. Several of the commenters agreed with the Agency's proposed definition. The large majority of comments, however, expressed some concern with the Agency's ignitability characteristic. These comments have been categorized by either content or the portion of the regulation addressed. A discussion of these follows:

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* EPA held five public hearings to receive comment on the proposed hazardous waste regulations. The hearings were held in New York City (2/7-9/1979), St. Louis, Mo. (2/14-16/1979), Washington, D.C. (2/20-22/1979), Denver, Co. (3/7-9/1979), San Francisco, Cal. (3/12-14/1979).

A. Comments on Ignitable Liquids

1. A large majority of the comments objected to the Agency's proposed limit for ignitable liquids (140°F).

- Many of the commenters suggested that EPA amend the proposed regulations and adopt DOT's limit for flammable liquids (100°F). These commenters argued as follows: (1) the higher flash point limit chosen by EPA is not justified since it is doubtful whether higher temperatures will be encountered during the disposal of hazardous wastes than during transportation, (2) past drafts of the ignitability background document list only two landfill fire incidents in which the first material ignited was known and in both incidents the flash point was less than 100°F, (3) the DOT flash point limit is based on experience and has provided adequate protection against ignitable hazards in the past, (4) there is some question whether the 140°F EPA flash point will capture significantly more hazardous waste than the 100°F DOT flash point, (5) EPA's use of a different flash point limit from that employed by DOT will create confusion in complying with DOT's placarding, containerization and manifest requirements and, (6) EPA's use of a different flash point goes against the stated intent of RCRA to integrate its provisions with those of DOT and other agencies. In none of these comments was any supporting data presented for changing the flash point limit to 100°F.

The Agency disagrees with these comments for several reasons. As noted above, a number of EPA studies indicate that landfill temperatures frequently exceed the limit of 100°F adopted by DOT. Temperatures of as high as 170.6°F(77°C) were experienced at or near the surface of test landfill plots. These recorded temperatures indicate that a flash point limit higher than DOT's is justified by the conditions likely to be encountered during disposal. Furthermore, DOT's 100°F flash point limit does not appear to take into account all of the heat sources available to ignitable materials during transportation and storage. J.M. Kuchta, et al., in an early DOT study [10], recommended "...that a flammable liquid be defined as one with a flash point below 140°F ...because temperatures of this order can be encountered during shipment ..." Indeed, DOT's adoption of a 130° test temperature in its metal corrosion standard in effect constitutes an acknowledgment that temperatures of greater than 100°F are likely to be encountered during transportation and storage (49 CFR 173.240).

The Agency disagrees with the statement that the DOT requirement has in the past provided adequate protection against fire incidents during transportation and storage. The Agency reviewed the NFPA files and found that 18 percent of the fires in the "storage property" category; 13 percent of the fires in the "transportation vehicle, structure" category; and 18 percent of the fires in the "open-field-dump" category were started by materials or wastes with flash points greater than 100°F (Table 5 and 6). This data[17] tends to demonstrate that liquids with flash points greater than 100°F present a significant ignitability hazard.

The Agency acknowledges that its damage files show only two landfill fires in which the "first material ignited" was known and that, in both cases, the flash points were less than 100°F. However, the Agency considers this irrelevant because it has never studied landfill fires. Similarly, industrial and insurance companies rarely investigate the causes of landfill fires because such fires rarely result in a "large loss." The available data from NFPA, indexed in

Table 3, nevertheless shows that wastes with flash points over 100°F do present a landfill fire problem.

The Agency does not believe that its use of a flash point limit different from that employed by DOT will cause undue confusion to the regulated community or interfere with DOT's placarding, containerization and manifest requirements. The term "ignitability" was selected to minimize any confusion to the regulated community since this community is already familiar with the terms "flammable" and "combustible." EPA's RCRA regulations impose essentially no new placarding or containerization requirements for the transportation and storage of ignitable hazardous wastes other than those already imposed by DOT. The most significant new shipping requirement imposed by the RCRA regulations is that transporters of ignitable wastes comply with the manifest requirement but this requirement is capable of being easily integrated with DOT's own shipping paper requirements. Furthermore, the tests which generators are required to conduct under the RCRA regulations are the same tests required under the DOT regulations.

TABLE 5 (CONT.)

NFPA's Report Involving Flammable/Combustible Liquids as the First Material Ignited [17]*

Fixed Property Use **	Class I *** Flammable Liquids Number of Fires	Class II *** Combustible Liquid Number of Fires	Class III *** Combustibel Liqu Number of Fires
Manufacturing			
Food	7	3	2
Beverage, Tobacco, Liquor	6	3	
Textile	5	2	1
Footwear, Wearing Apparel (Leather Rubber)	2		2
Wood, Wood Product	30	3	13
Chemical, Plastic, & Petroleum	33	5	12
Metal, Metal Product	21	15	60
Vehicle Assembly	12	3	5
Storage Property	93	11	9
Special Property			
Any unoccupied & under construction	13		
Transporation vehicle, sturcture	277	28	12
Open field, dump	23	5	

*The data base from which the incidents were selected includes principally the more serious fires which occurs in the United States. Although the sample of incidents included here is sufficient to identify and study signigicant fire problems, it should not be taken as representative of fires of all severities. The period covered by this report is 1971-1976.

**Defined by NFPA 901-see standard for further explanation.

***Defined by NFPA 30-see standard for further explanation.

TABLE 5

NFPA's Report Involving Flammable/Combustible Liquids as the First Material Ignited 17*

Fixed Property Use**	Class I *** Flammable Liquids Number of Fires	Class II *** Combustible Liquid Number of Fires	Class III *** Combustible Liq Number of Fires
Public Assembly	51	4	1
Educational	17	1	
Institutional	2		1
Residential			
1&2 Family Dwelling	202	48	4
Apartment House, Hotel, etc	129	26	3
Store/Office	151	8	2
Basic Industry, Utility, and Defense	10	7	29

*The data base from which the incidents were selected includes principally the more serious fires which occurs in the United States. Although the sample of incidents included here is sufficient to ident and study signigicant fire problems, it should not be taken as representative of fires of all severities. The period covered by this report is 1971-1976.

**Defined by NFPA 901-see standard for further explanation.

***Defined by NFPA 30-see standard for further explanation.

TABLE 6

Percent Class II and Class III Fires as First Material Ignited[17]

Fixed Property Use	Class II Combustible Liquids % of Total *	Class III Combustible Liquids % of Total **
Public Assembly	7	2
Educational	6	
Institutional		33
Residential		
1&2 Family Dwelling	19	2
Apartment House, Hotel, etc.	16	2
Store/Office	5	1
Basic Industry, Utility, and Defence	15	63
Manufacturing		
Food	25	17
Beverage, Tobacco, Liquor	33	
Textile	25	12
Footwear, Wearing Apparel (Leather Rubber)	7	50
Wood, Wood Product		28
Chemical, Plastic, & Petroleum	10	24
Metal, Metal Product	16	63
Vehicle Assembly	15	25

*% of Total = #of Class II Fires (Table 1.4.1)/(Class I + Class II + Class III)

**% of Total = #of Class III Fires (Table 1.4.1)/(Class I + Class II + Class III)

TABLE 6 (CONT.)

Percent Class I and Class III Fires as First Material Ignited 17

Fixed Property Use	Class II Combustibles Liquids % of Total *	Class III Combustible Liquids % of Total **
Storage Property	10	8
Special Property		
Any unoccupied & under construction		
Transporation vehicle, structure	9	4
Open field, dump	18	

* % of Total = # of Class II Fires (Table 1.4.1)/(Class I + Class II + Class III)

** % of Total = # of Class III Fires (Table 1.4.1)/(Class I + Class II + Class III)

While the Agency acknowledges that maintaining consistency between its Section 3001 regulations and those of DOT is a desirable goal, it does not believe that such consistency should be achieved at a sacrifice of environmental protection. Lowering its flash point limit to 100°F would exclude from regulation wastes which present a real hazard. Congress explicitly contemplated such disagreement between EPA and DOT when it provided at Section 3003 of RCRA that the Administrator "is authorized to make recommendations to the Secretary of Transportation respecting the regulation of ...hazardous waste under the Hazardous Materials Transportation Act and for addition of materials to be covered by such Act."

- A number of commenters argued that EPA's definition of ignitable waste could be made consistent with DOT's regulations by adopting both DOT's definition of flammables (F.P. 100°F) and DOT's definition of combustibles (F.P. 100°F - 200°F) and including both categories within EPA's ignitable waste classification.

EPA originally considered controlling wastes with a flash point of up to 200°F. However, the Agency concluded that, even though such wastes might present a hazard once ignited, wastes which are easily ignited under conditions encountered during transportation, storage, and disposal present the greater danger. Therefore the Agency elected not to control wastes with a flash point of up to 200°F under Subtitle C of RCRA and believes that to control such wastes would create an additional burden and expense to the regulated community, which is not justified solely by considerations of consistency.

- One commenter suggested that the Agency develop a two-tier system for defining ignitable liquids by adopting the DOT flammable category for wastes with flash points less than 100°F and adding a combustible category for wastes with flash points from 100°F to 140°F. The primary justification given for this two-tier system was the assertion that the 140° temperature specified in the ignitability flash point limit might be applicable to the disposal of wastes in landfills but not to transportation of wastes. No data was presented in support of this assertion.

The Agency disagrees with this comment for two reasons. First, as noted above, the DOT flash point limit of 100°F does not take into account the full range of temperatures likely to be encountered during the transportation of hazardous wastes. J.M. Kuchta, et al., in an early DOT study, recommended that DOT adopt a flash point limit of 140°F for flammable liquids because temperatures of this order can be encountered during transportation. Second, erecting a two-tier system in which some wastes were regulated for purposes of disposal but not for purposes of transportation would not be compatible with the hazardous waste management system mandated by the Act and the regulations. The Act envisions and the regulations require a comprehensive "cradle-to-grave" management control system which tracks hazardous waste from its point of generation to ultimate disposal. Piecemeal regulation of waste for disposal purposes would be administratively infeasible and not in accordance with this system.

- Several commenters pointed out that under DOT's regulations, "combustible" liquids packed in containers of 110 gallons or less are exempted from DOT's placarding, containerization, etc. requirements. These commenters argued that since EPA intends to regulate 110 gallon quantities of "combustible" liquids with flash points in the range 100°F - 140°F, confusion will result.

The Agency believes that any confusion caused by the Agency's regulation of 110 gallon quantities of DOT defined combustibles will be minimal. Most generators who ship in less than 110 gallon quantities will probably fit within the Agency's "small generator exemption" and will thus not be subject to any EPA-imposed shipping requirements. It should not cause any undue confusion to require generators who ship in less than 110 gallon quantities but do not fit within the "small generator exemption" to observe DOT placarding, etc. requirements.

- Several commenters proposed that the Agency eliminate the inconsistency between its ignitable standard and DOT's flammable and combustible standards by petitioning DOT to raise its flash point limit for flammable liquids to 140°F. The Agency has requested DOT to change its flash point limit for flammable liquids to 140°F, but DOT refused.
- Some commenters expressed concern that the Agency's ignitability definition would include waste fuel oils which could be burned as fuel oil and thus put to a beneficial re-use. The regulations promulgated today will not include waste oils which are beneficially reused or reclaimed. Waste fuels which are put to beneficial re-use will thus not be regulated as hazardous.
- One commenter argued that the autoignition temperature is a better measure of the hazard presented by liquid waste than the flash point.

This comment has been adequately responded to above and needs no further response here.

2. A number of comments objected to the proposed test protocols for the ignitability flash point limit (140°F).

- Several commenters argued that an open cup flash point analysis better simulates landfill conditions and is therefore a better measure of the hazard presented by liquid ignitables than a closed cup flash point analysis.

  The Agency does not disagree than an open cup analysis can simulate landfill conditions. However, as noted above, the closed cup tester was selected because it simulates the most dangerous type of hazardous waste situation -- that is, the situation where ignitable liquid vapors collect in a confined space such as a storage area or a structure adjacent to a landfill. Another reason the closed cup tester was selected is that the open cup tester does not give results which are as reproducible as those of the closed cup tester.

- Several commenters agreed with the upper flash point limit of 140°F using the closed cup method but also urged the Agency to include an optional limit of 100°F using the open cup method. The basis for this suggestion was that some reference books only present open cup data.

  The Agency disagrees with these commenters on two counts. First, most reference books list flash points only for pure substances and simple mixtures. Waste streams are complex mixtures whose flash points can only be ascertained by testing and not by consulting a reference book. Secondly, a liquid tested in a closed cup tester generally flashes at a lower temperature than the same liquid tested in an open cup. Consequently, if the Agency were to prescribe an optional open cup flash point limit equivalent to its closed cup flash point limit, that limit would of necessity be higher than the closed cup limit. Unfortunately, the Agency has not discovered an appropriate means of equating the two types of testers.

3. A number of commenters argued that the ignitability characteristic improperly includes many liquid wastes such as wine, latex paint and other water borne coatings which contain low concentrations of volatile organics such as alcohol and will consequently exhibit flash points below 100°F but will not sustain combustion because of the high percentage of water present. These commenters urged that the regulations should either specifically exempt such wastes or that the test for ignitability should be expanded to include alternative test methods such as the British Combustibility Test or the ASTM Wick Test which measure the ability of materials to sustain combustion. These commenters pointed out that DOT currently excludes from its flammable category aqueous solutions containing 24 percent or less alcohol by volume.

The Agency generally agrees with the concerns expressed by these commenters. However, problems do exist in formulating an acceptable solution. The Agency has at present no data which identifies the relationship between the concentration levels of volatile organics in aqueous solutions and the established flash point of 140°F. Consequently, the Agency has opted, for the time being, to use an exclusion similiar to that prescribed by DOT and exempt from the ignitability characteristic aqueous solutions with alcohol concentrations of less than 24 percent by volume. This exclusion will remove from the ignitability characteristic such things as wine and latex paint which flash at less than 100°F but will not sustain combustion. The Agency will undertake additional work to determine whether this alcohol/water limit is sufficient or whether another limit is more appropriate. Once development of the British Combustibility Test and the ASTM Wick Test is completed, the Agency will also evaluate these two proposed supplemental test methods to determine whether they can be used.

4. One commenter suggested that the Tag Closed-Cup Tester (ASTM method D-56) be included in the regulations as an equivalent methods in testing ignitable liquids. The commenter argued that since this method was allowed by DOT to test ignitable liquids, EPA should also allow this method in order to avoid needless duplicate testing.

The Agency has not designated the Tag Closed Cup Tester as an acceptable tester because the Tag Closed Cup Tester does not incorporate a stirrer and thus is not suitable for testing wastes which are very viscous, skin over, tend to stratify or contain suspended solids. Since most liquid wastes are expected to be in sludge or semi-solid form, the usefulness of the Tagliague Closed Cup Tester was judged to be limited. The regulated community is, however, still free to demonstrate under the procedures provided in §§260.20 and 260.21 that the Tag Tester is equivalent to the specified methods.

5. One commenter argued that an ignitable waste should simply be defined as a waste that is being handled at a temperature greater than its flash point.

The Agency disagrees with the commenter. The commenter's proposed definition would make the hazardousness of a given waste entirely dependent on the handling that waste was getting at a particular moment. Such a highly variable definition of hazardous waste would make identification of ignitable wastes and enforcement of the regulations impossible.

B. Comments on Ignitable Solids

1. A large number of commenters disagreed with the proposed definition for solid ignitable wastes. Many commenters argued that the definition as proposed could be construed to include many non-hazardous materials such as bark, wood chips, wastepaper, corrugated boxes, tires, grass, etc. and suggested that the definition be revised

to make clear that this result was not intended. Some of the commenters suggested that the definition be clarified by eliminating the phrase "or when ignited burns so vigorously and persistenly as to cause a hazard during management." Others suggested changing "or when ignited burns so vigorously and persistently as to create a hazard during its management" to "and when ignited burns so vigorously ..."

As indicated earlier, the Agency has no intention of designating such things as waste paper, saw dust, etc. as hazardous. It is only interested in designating solids which are liable to cause fires through friction, absorption of moisture, etc as hazardous. Such solids are thermally unstable and will often fit within the reactive classification as well as the ignitable classification. To reflect this intention, the Agency has amended its final regulation by changing "or when ignited burns so vigorously ..." to "and when ignited burns so vigorously ..." This language makes clear that the Agency does not consider materials which simply burn vigorously such as wastepaper to be hazardous.

2. Several commenters argued that the definition as proposed was too vague and did not provide the generator with enough guidance for determining whether or not his waste was ignitable. These commenters went on to recommend that a more specific test be established for solid ignitables.

The Agency considers the prose definition of solid ignitables to be sufficiently specific to enable the generator to determine whether or not his waste is hazardous under the regulations. Most generators whose solid wastes are dangerous due to their ignitability will be well aware of this property since ignitable solid wastes present special problems in handling, storage and transport. It will only be rare instances that a generator would be unsure of the ignitability of his solid waste or unable to assess whether the waste fits the prose defintion. Unfortunately, as noted above, no test methods have been adequately developed which adequately measure the ignitability hazard presented by solid wastes. Therefore until an adequate test method is developed, the Agency will continue to use a prose definition for non-liquid ignitables.

3. Several commenters pointed out that the proposed definition classify slags from refining operations as hazardous on the basis of their retained heat. These commenters argued that inclusion of these slags as ignitable was outside the intent of Congress and suggested that the regulation be modified to exclude slags.

In proposing the non-liquid (solid) ignitability definition, the Agency was concerned with wastes such as slags which retain a considerable amount of heat and which, if placed in a landfill, could present a problem by raising the temperature of other wastes to their flash points. However, in re-evaluating this class of wastes, the Agency believes that these wastes are produced in such high volume that they would never end up in a sanitary landfill and present the problem as described in the above scenario. Therefore, the Agency has amended the regulation by deleting the following phrase "...or retained heat from manufacturing or processing."

C. Comments on Ignitable Gases

1. One commenter suggested that the term "ignitable compressed gases" be changed to "flammable compressed gas" as defined by DOT in 49 CFR 173.300 (b).

The term "ignitable" has been used by the Agency to maintain consistency with the rest of the Agency's ignitability definition. It should be clear from the definition that, insofar as compressed gases are concerned, the Agency's use of "ignitable" and DOT's use of "flammable" are indistinguishable. Therefore, there is no need to modify the final regulation as suggested by the commenter.

2. One commenter recommended that ignitable compressed gases be excluded from the definition of ignitable waste since the main hazard presented by gases occurs during transporation.

The Agency disagrees with this commenter. An ignitable contained gas, with pressure greater than

40 lbs. per sq. inch, could present a danger to human health and the environment through the leaking or rupture of the container during handling or disposal, as well as during transportation.

D. Comments on Ignitable Oxidizers

1. One commenter requested further clarification on the definition of oxidizer.

49 CFR 173.151 defines an oxidizer as "a substance such as chlorate, permananganate, inorganic peroxide, nitro carbo nitrate, or a nitrate, that yields oxygen readily to stimulate the combustion of organic matter." Section 173.151a goes on to define the term organic peroxide. This definition is as good a description of oxidizing compounds as has been developed short of using a test method with a quantitative limit. Unfortunately, as noted above, an appropriate test method has not been developed by the Agency or any other organization and until one is found the proposed definition will be used.

2. One commenter questioned the possible overlap between ignitable oxidizers and reactive oxidizers. The commenter went on to question whether these wastes would have to be recorded as both reactive and ignitable on manifests and reports.

The difference between ignitable oxidizers and reactive oxidizers is largely a matter of degree.

Thus, it is almost impossible to draw a clear line between the two. However, for purposes of these regulations, an oxidizer which reacts violently should be considered a reactive waste; on the other hand, an oxidizer which reacts in a milder manner, should be considered an ignitable oxidizer. In the main, the most important consideration is that these oxidizers be controlled sufficiently to prevent danger to human health and the environment.

E. Summary of Data on the Ignitability Tester Published in the NUS Report* and Response to Comments Received on that Noticed Report

On December 28, 1979 (44 FR 49278), the Agency noticed a report for comment which contained the results of running the PenskyMartens flash point tester to determine the flash points of two selected waste sludges. The flash point determinations were presented at Table 5, (pg.47), and included the following explanation:

> The ignitabilty (flash point) test results obtained by the Pensky-Martens Closed Tester are exhibited in Table 5. The ASTM method states that results submitted by each of two laboratories should be considered suspect if the results differ by more than 3.3°C (6°F) for suspensions of solids having a flash range between 35 to 43.3°C (95 to 110°F). The procedure further states that the reproducibility between the average of duplicate results by two individuals or laboratories would be considered suspect if the results differ by

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*"Evalution of Solid Waste Extraction Procedures and Various Hazard Identification (Final Report)", NUS Corporation, September, 1979.

TABLE 5

ANALYSIS RESULTS FOR IGNITABILITY TESTS

Sample	Laboratory	Flash Point C	Flash Point F
Refinery Sludge (Tank Bottoms)	J	31.1	88
	K	-5.6	22
Paint, Pigment Sludge	J	33.3	92
	K	43.3	100
Refinery Sludge (Tank Bottoms)[a]	J	>82.2	>180
	K	>93.3	>180*

[a] Same sample, repeat analysis; no explanation can be offered for the differences.

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*One commenter noted that the F° conversion for >93.3 was incorrect (i.e., the conversion of >93.3°C should be >200°F not 180°F). The Agency agrees with this commenter.

> more than 10°C (18°F) for viscous and/or heavily pigmented materials (e.g., paint and pigment sludge). The refinery sludge (tank bottoms) results are definately not in agreement, whereas the paint and pigment sludge results are considered questionable.

NUS made these conclusions about the Pensky-Martens tester and the two samples:

> The Pensky-Martens Closed Cup Tester gave inconsistent results for the refinery sludge (tank bottoms) and marginal results for the paint and pigment sludge. The refinery sludge was an oily mixture containing water, and variable results can be expected for a nonhomogeneous sample of this type. The paint and pigment sludge was highly viscous. The Pensky-Martens Closed Cup Tester or equivalent is acceptable for homogeneous mixtures containing a large fraction of flammable volatiles. However, industrial wastes which are viscous, heavily pigmented, and/or nonhomogeneous are expected to give inconsistent and perhaps conflicting test results. A different method may provide better results with other sample types.

Two commenters stated that the results presented in the NUS report seriously question both the validity and reproducibility of the procedure. One commenter argued that given the contradictory results from the NUS ignitability tests, additional developmental work needs to be conducted to better define the test conditions and parameters of the test. Another commenter stated that, until this was done, the scientific basis for defining ignitable hazardous waste would be inadequate. A third commenter stated that inconsistent and perhaps conflicting test results are expected for other viscous, heavily pigmented wastes. The first commenter noted that, in the refinery sludge sample, the difference in flash point measurements between the two laboratories was 36.6°C or 66°F, and that when the samples were again run, the results were vastly different. This commenter further noted that in this second run laboratory J, which had initially reported a value of 31.1°, reported a value of >82.2°C, a value which was totally unaceptable since 82.2°C is a temperature that should be determined with precise accuracy by the use of commonly available equipment.

The Agency believes that these commenters may have been somewhat rash in condemning an industrially accepted standard test method (the Pensky-Martens Closed Cup Tester - American Society for Testing Materials Standard D-93-72) based on the review of trial runs performed on two samples. This test method has for a number of years been used successfully by the Department of Transportation in its regulation of hazardous materials. The Agency agrees that the (1) non-homogeneous nature of one sample and (2) the high viscosity of the other may have surpassed the limits of the particular test*. However, the Agency does not agree that the two test results reported in the NUS report are sufficient indication that the test may not be reproducible. A large number of circumstances could have produced this difference in flash points. Difficulty in sampling and splitting oil/water mixtures, insuring that light volatile fractions do not escape during handling, and sample preservation all could have contributed to false readings. Next, the same samples were run through the flash point test at different times. (The tank bottom sample was first run in the laboratories in November of 1978; these samples were then tested again in February of 1979. The result of which produced the much higher flash points of >180°F. In disagreement with the commenter, this is an acceptable way to present the data, as the samples began to boil around 180°F and the test had to be terminated. The Agency was in error in having the tank bottom sample re-tested after such a delay in time and not reporting so. The other waste stream to be tested (paint and pigment sludge) was a highly viscous homogeneous waste with suspended solids. No viscosity determination was made before the test. The result for this test showing a 18°F difference between the two laboratories is a very good result considering the extreme viscosity of the sample, only one test performed at each laboratory, and lack of a sample preservation technique. Observations made during the test were not reported.

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*In promulgation of the ignitability standards in todays Federal Register, the most current test standards will be incorporated (i.e., Pensky-Martens Closed Cup Tester D93-78). This updating should improve the applicability of the test methods to sludge because of the incorporation of dewatering techniques and viscosity limits.

One commenter argued that the additional cited document did not provide validation of the characteristic test method for listing or delisting. The Agency agrees with this commenter. However, the primary objective in running the test was to develop additional baseline data on running wastes in the Pensky-Martens Closed Cup Test, not to validate the test. The Agency assumes that this test method has already been validated since the test method has been adopted by DOT in their transportation regulations and is commonly accepted by industry as a standard test method.

One commenter presented a rationale that explains the failure of the two laboratories in relating equivalent results. Stating, such results can be obtained in the event that the sampling procedures, subsampling procedures, and finally the individual test sampling procedures are not all representative of the starting material. The commenter goes on to say that what is needed is a method of obtaining a small representative portion of these materials. That is to say, a sample of approximately 100-150 ml which is in turn representative of the original sample, e.g., a lagoon or holding tank. Such materials are, frequently, themselves inhomogeneous and contain lumps and even rubbish so that a truly representative sample from all strata within the holding tank or lagoon and from various locations should be appropriately composited into a large vessel. This large initial vessel, possibly a five gallon container or even a fifty-five gallon drum, itself should be tightly capped during storage and thoroughly homogenized before subsamples are taken. Also, the commenter suggests that after the test samples have been obtained, they should be introduced without delay into the Pensky-Martens apparatus at room temperature. If the sample flashes immediately, another sample aliquot should be cooled and introduced into a clean cooled Pensky-Martens apparatus. Further, the flash point technician should be thoroughly trained in the sciences of running the Pensky-Martens apparatus. This commenter also relates that in their experience lumps of material and bumping during the stirring process can lead to spuriously high or spuriously low flash points. The commenter recommends that the testing be reported in duplicate (do not average). If values disagree by more than some specified value (pick a number), then run samples in duplicate on another test date. Report all data obtained together with all anecdotal information, e.g., "couldn't stir sample," "sample foamed," "boiled over," "extinguished flame."

The Agency feels that this commenter's suggestions are very much in order. EPA is currently developing a sampling methodology, sample preservation, and sample splitting handbook which will be available to the public. The problem of obtaining a representative sample of a particular waste stream so that appropriate testing can be accomplished has been a concern of the Agency and it's contractors who must sample and analyze waste streams. The Agency agrees that reporting anecdotal information or observations made during a test is necessary. Data collection on very viscous, high solids, and/or nonhomogeneous sludges will be the way the Agency assesses the hazard of sludges which because of some physical restraint are outside the limits of a particular tester. This is not to say that what is not reproducible in one standard is reproducible in another. The Agency again agrees with this commenter in that more information should be reported concurrently with flash points so that proper hazard evaluation can be made.

V. Promulgated Regulation

As a result of EPA's review of the comments regarding the ignitability characteristic, EPA is promulgating an ignitability characteristic which differs from the proposed regulations in two aspects. First, the definition for liquid ignitables specifically excludes wastes which have a flash point less than 140°F and contain 24 percent or less alcohol by volume; secondly, the definition for non-liquid ignitables has been clarified to better reflect the Agency's regulatory intent.

§261.21 Characteristic of ignitability

(a) A solid waste exhibits the characteristic of ignitability if a representative sample of the waste has any of the following properties:

(1) It is a liquid, other than an aqueous solution containing less than 24 percent alcohol by volume, and has a flash point less than 60°C (140°F), as determined by a Pensky-Martens Closed Cup Tester, using the test method specified in ASTM Standard D-93-79, or a Setaflash Closed Cup Tester, using the test method specified in ASTM standard D-3278-78, or as determined by an equivalent test method approved by the Administrator under the procedures set

forth in §§260.20 and 260.21.*

(2) It is not a liquid and is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard.

(3) It is an ignitable compressed gas as defined in 49 CFR 173.300 and as determined by the test methods described in that regulation or equivalent test methods approved by the Administrator under §§260.20 and 260.21.

(4) It is an oxidizer as defined in 49 CFR 173.151.

(b) A solid waste that exhibits the characteristic of ignitability, but is not listed as a hazardous waste in Subpart D, has the EPA Hazardous Waste Number of D001.

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*ASTM Standards are available from ASTM, 1916 Race Street, Philadelphia PA 19103.

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Appendix I

Examples of Accidents
Involving Ignitable Waste

Kovalick, Walter W., Volatility of Hazardous Waste (Information) Memo to John P. Lehman, OSW, EPA. August 15, 1975.

East St. Louis, St. Clare County

The Mal-Milam landfill has accepted various industrial wastes for more than ten years. Some of these wastes come from the Chrysler Corporation and Mallinkrodt Chemical Works and include solvents (phenols) and wastes from plastics manufacture. Two serious fires occured at the site during compaction operations on August 29, 1973 and on April 4, 1974. The fires burned for two days and involved personal danger and much difficulty to extinguish. Only after the second fire when the disposed permits came under review were changes made in the operation. Fire protection handbook lists phenol (C_6H_5OH) with a flash point of 175°. Waste from plastics manufacturing may include a number of ignitable solvents and their still bottoms.

Illinois

Chicago, Dan Ryan Expressway

Several dozen barrels of chemical waste exploded in a truck bin on the Dan Ryan Expressway, spewing barrels and flames over cars and snarling rush-hour traffice on all four Chicago expressways. The explosions occured at 3:15 p.m. on the elevated portion of the Ryan Expressway. The chemical believed to be sodium nitrate, was part of a load being carried by an industrial garbage truck to a garage in Crestwood from a chemical company on West 18th Street. Barrels which were catapulted into the air landed among the cars or dropped 50 feet to the ground level. Two policeman were treated for eye injuries from the smoke. Sodium nitrate is a D.O.T. oxidizer and being such is an EPA ignitable oxidizer.

Pennsylvania

Harrisburg, Dauphin County 1/75

An explosion occurred at the Harrisburg City incinerator which resulted in building damage totaling approximately $95,000. The explosion resulted from the ignition of a drum of spray adhesives delivered by the Rolance and Rolance Supply Co. Proper disposal of these adhesives would of prevented this dangerous situation. Municipal incinerators like municipal landfills are generally not equipped nor permitted to handle ignitable hazardous waste.

Pennsylvania

Whitemarsh Township, Montgomery County

Two explosions and the contamination of residential drinking water resulted from the development of methane gas in a landfill in Deck Quarry, Montgomery County, Pennsylvania. The gas moved through rock fractures. A well-pump spark ignited the gas causing explosions. Residents have evacuated their houses permanently and the contaminated well area has been vented by a trench and holes dug at the landfill in late 1969. The landfill accepted municipal and some industrial wastes until its closure in 1969. The migration of gases from landfills is a problem throughout the country. Organic solvents which volatilize at ambient temperatures (that is, less than 60° C) join with refuse degradation products causing concentration build-up in nearby structures, manholes, conduits, and in the ground itself. A detail analysis of landfill gas from a different landfill, one in California, showed fifty-some organic contaminates to the methane.[24]

New Jersey

Toms River, Berkeley Township

1500 or more deteriorating chemical drums buried in Berkeley Township, and considered potentially explosive by the state, could cause the relocation of a major Ocean County Sewerage Authority interceptor lines. The presence of the hazardous drums known to State Department of Environmental Protection since 1974 has resulted in hiring an engineering firm to monitor ground water. One of the substances known to be buried at the site is metallic sodium (825 drums from Union Carbide buried in 1960) which is a ignitable solid. A fire at the dump site in 1974 was put out with dry sand after water made the flames worse. Metallic Sodium is an ignitable solid.

Illinois

Calumet, Cook County 9/75

A landfill operator died from severe burns when the compacter that he was operating struck a 55-gallon drum of ethyl acetate (flash point 24°). The incident occured after a scavenger/

hauler had deposited a load at the Calumet Industrial Development Landfill in the dark hours of the morning.

Washington

Everett, Snohomish County 9/74

The N.W. Wire Rope Corp., cleaning off debris from the site of a metal reduction plant, sent 200 cubic yards to a landfill near Siver Lake. The debris consisted of aluminum dust, magnesium chips, and two broken drums of concentrated phosphorus. Upon dumping and compaction, the material ignited and developed into a fire. Water could not be applied to the waste and explosions eliminated chances to obtain samples need for analysis. The fire started after the improper disposal of ignitable solids.

Michigan

Forest Waste Disposal, Genesee County

While burying drums containing an unknown waste, a bulldozer operator at the Forest Waste Disposal Landfill began experiencing dizziness and eye irritations. As a result, he left his bulldozer and upon returning found the machine in flames. Evidently, some of the drums contained ignitable solvents and the waste hauler, Berlin and Farrow, was supposed to incinerate their ignitable waste. The wastes were generated by the Saganough Steering Gear Co. Landfill owner is contemplating legal action against the waste hauler.

Ohio

Elda, Inc. Dump, Cincinnati

An employee of a private dump was burned over 50 percent of his body when several containers of unknown volatile liquid caught fire and enveloped his bulldozer. The employee was attempting to put out a small fire when the bulldozer hit the containers. Firemen were hampered because no hydrants were located at the dump. The problem of unidentified ignitable solvents being placed in municipal landfills keeps cropping up. Danger to landfill personnel and degradation of the environment occur from this waste.

Pennsylvania

Springfield Township, Delaware County

The Mayer landfill of Delaware County, Pennsylvania, formly accepted various kinds of industrial wastes. At times, tank-car quantities were dumped at the site as well as many barrels of unidentified chemical wastes. During compaction operations in 1971, an explosion occurred which destroyed a bulldozer and caused a fire that burned for several days. Problem disposal sites like this exemplify the need for ignitable waste controls.

Appendix II

Regulation of States, Organizations, Agencies

Regulations of States

California[18]

Flammable. (a) "Flammable means:

(1) A liquid which has a flash point at or below 37.8 degrees centigrade (100 degrees farenheit) as defined by procedures described in Title 49, Code of Federal Regulations, Section 173.115.

(2) A gas for which a mixture of 13 percent or less, by volume, with air forms a flammable mixture at atmospheric pressure or the flammable range with air at atmospheric pressure is wider than 12 percent regardless of the lower limits. Testing methods described in Title 49, Code of Federal Regulations, Section 173.115, shall be used.

(3) A solid which is likely to cause fires due to friction, retained heat from processing or which can be ignited under normal temperature conditions and when ignited burns so as to create a serious threat to public health and safety. Normal temperature conditions means temperatures normally encountered in the handling, treatment, storage and disposal of hazardous wastes.

(4) A gas, liquid, sludge or solid which ignites spontaneously in dry or moist air at or below 54.3 degrees centregrade (130 degrees Fahrenheit) or upon exposure to water.

(5) A strong oxidizer. Section 60415 "Strong Oxidizer" means a substance that can supply oxygen to a reaction and cause a violent reaction, or sustain a fire when in contact with a flammable or combustible material in the absence of air.

Minnesota[19]

Flammable material: any material that:

a. has a flash point below 93.3°C (200°F), except the following:

    (1) a material comprised of miscible components having one or more components with a flash

point of 93.3°C (200°F), or higher, that make up at least 99% of the total volume of the mixture;

(2) a material that has a flash point greater than 37.8°C (100°F) and that when heated to 93.3°C (200°F) will not support combustion beyond the flash;

(3) an explosive material; or

b. may ignite without application of flame or spark including, but not limited to, nitro cellulose, certain metal hydrides, alkali metals, some oily fabrics, processed metals, and acidic anhydrides.

Flash point: The minimum temperature at which a material gives off vapor within a test vessel in sufficient concentration to form an ignitable mixture with air near the surface of the material.

Oxidative material: Any material with the property to readily supply oxygen to a reaction in the absence of air. Oxidative materials include, but are not limited to, oxides, organic and inorganic peroxides, permanganates, chlorates, perchlorates, persulfates, nitric acid, organic and inorganic nitrates, iodates periodates, bromates, perselenates, perbromates, chromates, dichromates, ozone, and perborates. Bromine, chlorine, fluorine, and iodine react similarly to oxygen under some conditions and are therefore also oxidative materials.

Flammable materials: Whenever the flash point of a waste is to be determined, one of the following test procedures shall be used. The test chosen shall be appropriate for the characteristics of the waste that is tested.

(a) Standard Method of Test for Flash Point by Tag Closed Tester (ASTM D56-70).
(b) Standard Method of Test for Flash Point of Aviation Turbine Fuels by Setaflash Tester (ASTM D3243-73).
(c) Standard Methods of Test for Flash Point of Liquids by Setaflash Closed Tester (ASTM D3278-73).
(d) Standard Method of Test for Flash Point by Pensky-Martens Closed Tester (ASTM D93-73) or alternate tests authorized in this standard.

For any waste containing components with different volatilities and flash ponts and having a flash point higher than 93.3°C (200°F) according to the test procedure employed, a second test shall be conducted on a sample of the liquid portion of the material that remains after evaporation in an open beaker (or similar container), under ambient pressure and temperature (20 to 20°C) conditions, to 90 percent of original volume or for a period of four hours, whichever occurs first, with the lower flash point of the two tests being the flash point of the material.

Oregon[20]

Flammability is defined as:

(a) material which is readily ignited under ambient temperatures
(b) material which on amount of its physical form or environmental conditions can form explosive mixtures with air and which is readily dispersed in air, such as dusts of combustible solids and mists of flammable or combustible liquids
(c) material which burns with extreme rapidity, usually by reason of self-contained oxygen, materials which ignite spontaneously when exposed to air
(d) liquids, solids or gasious material having a flash point below 37.8°C (100°F).

Ohio[3]

Flash points below 175°F

Very volatile flammable liquids, very flammable liquids and gases, and substances that, in the form of dusts or mists readily form explosive mistures when dispersed in air.

Washington[21]

Flammable: substances which have a flash point at or below 40°C (100°F), as determined by the Tagliabue open cup tester, or other suitable method.

Agencies and Organizations

Department of Transportation[2]

(1) flammable liquids are those having flash points below 37.8°C (100°F).

(2) combustible liquids are those having flash points at or above 37.8°C (100°F) and below 93.3°C (200°F).

(3) a flammable solid is any solid material other than one classified as an explosive, which, under conditions normally incidental to transportation is liable to cause fires through friction, retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious transportation hazard.

Consumer Product Safety Commission[22]

(1) the term "extremely flammable" shall apply to any substance which has a flash point at or below 20°F as determined by the Tabliabue Open Cup Tester

(2) the term "flammable" shall apply to any substance which has a flash point above 20°F, to and including 80°F, as determined by the tester mentioned above

(3) "Extremely flammable solid" means a solid substance that ignites and burns at an ambient temperature of 80°F or less when subjected to friction, percussion, or electrical spark

(4) "Flammable solid" means a solid substance that when tested by the method described in Section 1500.44, ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

Environmental Protection Agency (Title 40 (Pesticides), CFR, Part 162)

The proposed rulemaking includes flammability labeling requirements. "Extremely flammable" and "flammable" categories correspond to those found in Title 15, U.S. Code, Sec. 1261.

(1) Extremely flammable - a flash point less than 20°F.

(2) Flammable - a flash point greater than 20°F and less than 80°F.

(3) Combustible - a flash point greater than 80°F and less than 150°F.

National Academy of Sciences (Ad - 782 476):

Rating	Definition
0 - Insignificant hazard	Not Combustible
1 - Slightly hazardous	Flash point larger than 60°C (140°F)
2 - Hazardous	Flash point from 37.8 to 60°C (100 to 140°F)
3 - Highly hazardous	Flash point less than 37.8°C (100°F) and boiling point greater than 37.8°C (100°F)
4 - Extremely hazardous	Flash point less than 37.8°C (100°F) and boiling point less than 37.8°C (100°F)

National Fire Protection Association[23]

Flammable liquid shall mean a liquid having a flash point below 37.8°C (100°F) and having a vapor pressure not exceeding 40 pounds per square inch (absolute) at 37.8°C (100°F) and shall be known as a Class I liquid. Class I liquids shall be subdivided as follows: Class IA shall include those having flash points below 22.8°C (73°F) and having a boiling point at or below 37.8°C (100°F). Class IB shall include those having flash points below 37.8°C (100°F) and having a boiling point at or above 37.8°C (100°F). Class IC shall include those having flash points at or above 22.8°C (73°F) and and below 37.°C (100°F).

Combustible liquids shall be subdivided as follows:

Class II liquids shall include those having flash points at or above 37.8°C (100°F) and below 60°C (140°F).

Class IIIA liquids shall include those having flash points at or above 60°C (140°F) and below 93.3°C (200°F).

Class IIIB liquids shall include those having flash points at or above 93.4°C (200°F).

Booz-Allen Research, Inc., EPA, 1973 (PB 221-464):

A material is flammable if it has a flash point that is less than 37.8°C (100°F) and a boiling point less than 37.8°C (100°F) spontaneous combustion and/or explosive reaction.

Department of the Navy:

Hazard Level	Criteria
4	Flash point less than 100°F and boiling point less than 73°F.
3	Fp less than 100° and Bp greater than 73°F and less than 100°F.
2	Fp greater than 100°F and less than 200°F.
1	Fp greater than 200°F.
0	Material will not burn.

Appendix III

Definitions

These definitions are the working definitions of ASTM's Coordinating Committee on Flashpoint and Related Properties and Interaction with Government Agencies on these Properties.

NOTE: The Agency has used several of the definitions listed below, e.g. flash point in the body of the background document. The remainder are included as a standard for future work.

Autoignition -the spontaneous ignition (without an external ignition source) of a material as the result of heat liberation from an exothermic reaction.

Burning Velocity -fundamental velocity of a combustion wave measured normal to the flame front.

Combustible -capable of undergoing combustion.

Combustion -a rapid exothermic oxidiation process accompanied by continuous evolution of heat and usually light.

Deflagration -combustion which propagates into the reacting medium at a subsonic velocity.

Detonability Limits -the maximum and minimum concentrations of a combustible in an oxidant, e.g., air, which will propagate a detonation when initiated at specified temperature and pressure.

Detonation -combustion or other reaction which propagates into the reacting medium at a supersonic velocity.

Fire -the phenomenon of Combustion.

Fire Point -the minimun temperature to which a material must be heated in an open vessel to sustain combustion for a specified period of time after ignition by an external source.

Flame -a zone of gas or particulate matter or both in gaseous suspension that is undergoing combustion, as evidence by the evolution of both heat and usually light.

Flame Temperature -the temperature of the product species in flaming combustion.

Flame Speed -velocity of a combustion wave measured relative to a stationary observer.

Flash Point -the lowest temperature, corrected to a pressure of 101.3 kPa (1013 millibars), of a substance at which application of an ignition source causes the vapors above the substance to ignite under the specified conditions of test.

Ignite -to initiate combustion.

Lower Flammable Limit -the lowest concentration of a combustible substance that is capable of propagating a flame through a homogenous mixture of combustible substance and a gaseous oxidizer under specified conditions of test.

Lower Temperature Limits -the lowest temperature at which a combustible substance will produce a vapor concentration equal to the lower flammable limit under specified conditions of test.

Minimum Oxygen Concentration -the minimum concentration of oxygen required to sustain burning or flame propagation.

Temperature -the thermal state of matter as measured on a defined scale.

Upper Flammable Limit -the maximum concentration of a combustible substance that is capable of propagating a flame through a homogenous mixture of combustible substance and a gaseous oxidizer under specified conditions of test.

Liquid - (flammability regulations) -a substance that has a definite volume but no definite form except such given by its container. It has a viscosity of 1 x 10^{-3} stokes (1 x 10^{-7} to 1 x 10^{-1} m^2 s^{-1}) at 104° F (140° C) or an equivalent viscosity at agreed upon temperature. (This does not include powders and granular materials).

Liquids are divided into two classes:

CLASS A (low viscosity) a liquid having a viscosity of 1 x 10^{-3} to 25.00 stokes (1 x 10^{-7} to 25.00 x 10^{-4} m_ s^{-1}) at 104° F (40° C) or an equivalent viscosity at an agree upon temperature.

CLASS B (high viscosity) a liquid having a viscosity of 25.01 - 1 x 10^3 stokes (25.01 x 10^{-4} to 1 x 10 $^{-1}$ m^2 s^{-1}) at 104° F (40° C) or an equivalent viscosity at an agreed upon temperature.

note: The above definition of liquid does not apply to the meaning intended in this document but rather a general definition of ASTM.

Appendix IV

Test Methods for Ignitable Waste

Table of Contents

IV-1, 2---------------------------Tests to Determine Ignitable Gases (49 CFR 173.300)

IV-3------------------------------Test to Determine Ignitable Liquids (Pensky-Martens Closed-Cup ASTM)

IV-4------------------------------Test to Determine Ignitable Liquids (Seta-flash Closed Cup ASTM D3278-73)

IV-1,2 Aerosol Flame Projection Tests

The closed or solid end is equipped with one shuttered opening at the top. This is for the introduction of the spray. The opening is approximately two inches from the edge of drum head and is two inches in diameter. There is a safety glass or plastic window six inches square in the center of the solid end. A lighted plumber's candle is placed inside the drum on the lower side and midway between the ends.

PROCEDURE - The tests are conducted in the open and when temperature is between 60°F and 80°F.

---- OPEN DRUM TEST ----

This test is conducted with hinged end in a completely open position and with the shutter closed. The spray from the dispenser, with valve opened fully, is directed into the upper half of the open end and above the ignition source for one minute. Any significant propagation of flame through the vapor-air mixture away from the ignition source shall be considered a positive result -- but -- any minor and unsustained burning in the immediate area of the ignition source shall not be considered a positive result.

---- CLOSED DRUM TEST ----

This test is conducted with the hinged cover dropped into position to rest freely against the end and to close the open end of the drum to make a reasonably secure but not necessarily a completely air-tight seal. The shutter is opened and the spray is jetted into the drum through this shutter with valve fully opened for one minute. After clearing the atomsphere in the drum, the jetting is repeated similarly three times. Any explosion or rapid burning of the vapor-air mixture sufficient to cause the hinged cover to move is considered a positive result.

April, 1974

ASSOCIATION OF
AMERICAN RAILROADS
OPERATIONS AND MAINTENANCE DEPARTMENT · BUREAU OF EXPLOSIVES
AMERICAN RAILROADS BUILDING · WASHINGTON, D.C. 20036 · 202/293-4048

R. R. MANION
Vice-President

R. M. GRAZIANO
Director

AEROSOL FLAME PROJECTION TESTS

Section 173. 300(b) subparagraphs (2), (3), and (4) of Title 49 to the Code of Federal Regulations referenced The Bureau of Explosives' Flame Projection Apparatus, Open Drum Apparatus and Closed Drum Apparatus to be used when examining aerosol products.

The following are descriptions of the equipment and testing procedures to be used when conducting the tests. Any further questions relating to this testing should be addressed to the Director at the above address.

FLAME PROJECTION TEST

EQUIPMENT - The test equipment consists of a base four inches wide and two feet long. A thirty inch rule (with inches marked) is supported horizontally on the side of the base and about six inches above it. A plumber's candle of such height that the top third of the flame is at the height of the horizontal rule is placed at the zero point in the base.

PROCEDURE - The test is conducted in a draft-free area that can be ventilated and the atmosphere cleared between each test. The self-pressurized container is placed at a distance of six inches from the ignition source and the spray jetted into the top third of the flame with valve opened fully for periods of 15 - 20 seconds. The length of the flame projection from the candle position is read on the horizontal scale. Three or more readings are taken on each sample and the average is taken as the result. Samples are also tested with valve in partially open positions to test for "burning back" to valve.

DRUM TESTS

EQUIPMENT- The equipment consists of a 55 - gallon open-head steel drum or similar container which is placed on its side and fitted with a hinged cover over the open end that will open at a pressure of 5 p. s. i.

IV-3 ASTM D93-72

Pensky-Martens Closed Cup Tester

iv-6

NOV 7 1977

Designation: D 93 - 72

IP Designation: 34/71

American National Standard Z11.7 - 1972
Approved May 18, 1972
by American National Standards Institute
Method 1102—Federal Test
Method Standard No. 791b
Federation of Societies for
Paint Technology Standard No. Dt-5-68
British Standard 2839

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Standard Method of Test for
FLASH POINT BY PENSKY-MARTENS CLOSED TESTER[1]

ADOPTED (as method GO-7), 1924; LAST REVISED, 1971

This Standard of the American Society for Testing and Materials is issued under the fixed designation D 93; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. This is also a standard of the Institute of Petroleum issued under the fixed designation IP 34. The final number indicates the year of last revision.

This method was adopted as a joint ASTM-IP Standard in 1967.

1. Scope

1.1 This method covers the determination of the flash point by Pensky-Martens Closed Cup Tester of fuel oils, lube oils, suspensions of solids, liquids that tend to form a surface film under test conditions, and other liquids. For the determination of the flash point of drying oils and solvent-type waxes refer to Note 1.

NOTE 1—The flash point of drying oils may be determined using Method D 1393 and the flash point of solvent-type liquid waxes may be determined using Method D 1437.

NOTE 2—This method may be employed for the detection of contamination of lubricating oils by minor amounts of volatile materials.

2. Applicable Documents

2.1 *ASTM Standards:*

D 56 Test for Flash Point by Tag Closed Tester[2]
D 1310 Test for Flash Point of Liquids by Tag Open-Cup Apparatus[3]
D 1393 Test for Flash Point of Drying Oils[3]
D 1437 Test for Flash Point of Solvent-Type Liquid Waxes[4]
E 1 Specification for ASTM Thermometers[3]

3. Summary of Method

3.1 The sample is heated at a slow, constant rate with continual stirring. A small flame is directed into the cup at regular intervals with simultaneous interruption of stirring. The flash point is the lowest temperature at which application of the test flame causes the vapor above the sample to ignite.

4. Apparatus

4.1 *Pensky-Martens Closed Flash Tester,* as described in Appendix A1.

NOTE 3—There are automatic flash point testers available and in use which may be advantageous in the saving of testing time, permit the use of smaller samples, and have other factors which may merit their use. If automatic testers are used, the user must be sure that all of the manufacturer's instructions for calibrating, adjusting, and operating the instrument are followed. In any cases of dispute, the flash point as determined manually shall be considered the referee test.

4.2 *Thermometers*—Two standard thermometers shall be used with the ASTM Pensky-Martens tester, as follows:

4.2.1 For tests in which the indicated reading falls within the limits 20 to 200 F (−7 to +93 C), inclusive, an ASTM Pensky-Martens Low Range or Tag Closed Tester Thermometer having a range from 20 to 230 F (−5 to +110 C) and conforming to the requirements for Thermometers 9F (9C) and as prescribed in ASTM Specification E 1 or IP Thermometer 15F (15C) conforming to specifications given in Appendix A3, shall be used.

3.2.2 For tests in which the indicated reading falls within the limits 230 to 700 F (110 to 371 C), an ASTM Pensky-Martens High

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[1] This method is under the jurisdiction of ASTM Committee D-2 on Petroleum Products and Lubricants.

Current edition approved Aug. 29, 1972. Published October 1972. Originally published as D 93 - 21 1921. Last previous edition D 93 - 66.

In the IP, this method is under the jurisdiction of the Standardization Committee.

In 1971 the scope was revised.

[2] *Annual Book of ASTM Standards*, Part 20.

[3] *Annual Book of ASTM Standards*, Part 11.

[4] *Annual Book of ASTM Standards*, Part 22.

[5] *Annual Book of ASTM Standards*, Parts 18 and 30

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IV-4 D3278-73

SETAflash Closed Cup Tester

Appendix C

Designation: D 3278 - 73

AMERICAN SOCIETY FOR TESTING AND MATERIALS

1916 Race St., Philadelphia, Pa., 19103

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Standard Methods of Test for
FLASH POINT OF LIQUIDS BY SETAFLASH CLOSED TESTER[1]

This Standard is issued under the fixed designation D 3278; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

1. Scope

1.1 This method covers the determination of the flash point, by Setaflash® Closed Tester, of paints, enamels, lacquers, varnishes, and related products and their components having flash points, between 32 and 230°F (0 to 110°C) having a viscosity lower than 150 stokes at 77°F (25°C).[2]

NOTE 1—Tests at higher or lower temperatures are possible.

1.2 The procedure may be used to determine whether a material will or will not flash at a specified temperature or to determine the finite temperature at which a material will flash.

1.3 The results from this method are comparable to those obtained by the Tag Closed Tester procedure described in Method D 56[3] and the Pensky-Martens Tester method described in Method D 93.

2. Applicable Documents

2.1 *ASTM Standards:*

D 56 Test for Flash Point by Tag Closed Tester[2]

D 93 Test for Flash Point by Pensky-Martens Closed Tester[2]

D 850 Test for Distillation of Industrial Aromatic Hydrocarbons and Related Materials[2]

D 1015 Test for Freezing Points of High-Purity Hydrocarbons[2]

D 1078 Test for Distillation Range of Volatile Organic Liquids[2]

3. Summary of Method

3.1 By means of a syringe, 2 ml of sample is introduced through a leakproof entry port into the tightly closed Setaflash Tester or directly into the cut that has been brought to within 5°F (3°C) below the expected flash point. As a flash/no flash test, the *expected* flash point temperature may be a specification or other operating requirements. The temperature of the apparatus is raised to the precise temperature of the expected flash point by slight adjustment of the temperature dial. After 1 min, a test flame is applied inside the cup and note is taken as to whether the test sample flashes or not. If a repeat test is necessary, a fresh sample should be used.

3.2 For a finite flash measurement, the temperature is sequentially increased through the anticipated range, the test flame being applied at 9°F (5°C) intervals until a flash is ovserved. A repeat determination is then made using a fresh sample, starting the test at the temperature of the last interval before the flash point of the material and making tests at increasing 1°F (0.5°C) intervals.

4. Apparatus

4.1 *Setaflash Tester*[4], shown in Fig. X1, and described in Appendix X1.

4.2 *Thermometers*[5] conforming to specifica-

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[1] These methods are under the jurisdiction of ASTM Committee D-1 on Paint, Varnish, Lacquer, and Related Products.

Current edition approved Oct. 29, 1973. Published December 1973.

[2] *1974 Annual Book of ASTM Standards*, Part 29.

[3] *1973 Annual Book of ASTM Standards*, Part 18.

[4] Unit shown in Fig. X1 is manufactured by Stanhope-Seta Ltd., Park Close, Egham, Surrey, England. It is available in the USA from Erdco Engineering Corp., 136 Official Road, Addison, Ill. 60101, or from Paul N. Gardner Co., Station S, P. O. Box 6633, Fort Lauderdale, Fla. 33316.

[5] Thermometers may be obtained from the suppliers of the Setaflash

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APPENDIX E

Examples of Corrosive Wastes Causing Damage to Aquatic Life

Pennsylvania 1971

A sludge composed of spent pickle liquors and organic wastes and having a pH of 1.6 was stored in a mine pit behind a shale dam. Local residents complained of well water degradation, and a nearby pond turned highly acidic and became lifeless.

Pennsylvania 1972

An earthen dike at a refinery waste lagoon ruptured, releasing sludge with a pH of 1.7 into the Allegheny River. About 450,000 fish were killed along a 60 mile stretch of the river.

Pennsylvania 1973

A former tannery site with 2-4 million gallons of sulfuric acid, tannic acid, lime and sodium hydroxide stored in lagoons and tanks was destroyed by fire. During leveling operations 20,000 gallons of waste liquid spilled and drained into the Cowanesque River, killing everything for 7 miles.

Virginia 1971

A dike containing an alkaline waste lagoon for a steam generating plant collapsed and released 400 acre feet of fly ash into the Clinch River. The waste traveled down river for several days, until it reached Norris Lake where approximately 216,000 fish were killed. All food organisms in the four-mile stretch of river below Carbo were completely eliminated.

has been determined by the Agency, and they are discussed here in that context.

As the discussion in Section A of this Chapter explains, the Agency believes that tailoring of management requirements should be based primarily on two factors: the properties (or class of hazard) a waste presents, and the site specific conditions under which it would be managed. Some potential for tailoring based on degree of hazard considerations may also be appropriate on a case by case basis.

In the proposed regulations, the Agency incorporated some tailoring of requirements based on the type or class of hazard involved. For example, special requirements or conditions were included for ignitable, reactive, and volatile wastes, incompatible wastes, liquid wastes, and wastes containing halogens. Some flexibility was provided in the variances to the regulations as specified in notes.

The final Phase II regulations will expand the tailoring of regulatory requirements based on waste properties (i.e. class of hazard) and will greatly increase the overall flexibility to tailor regulatory requirements during the permitting process. The Part 265 Interim Status Standards and the partial Part 264 standards just promulgated relate largely to more administrative types of requirements, and thus are not conducive to significant tailoring. However, these regulations do incoporate a significant amount of flexibility. Both the Phase I and II management standards are discussed below.

Phase I Standards

The Agency believes that the Phase I standards are appropriate and necessary for all wastes, regardless of their degree of hazard. This is because many of the Phase I standards are minimum administrative requirements dealing with the manifest, recordkeeping, and repoting that are necessary for adequate tracking of wastes. The technical standards generally incorporate significant flexibility that allows tailoring of the requirements to the waste or site conditions. Since all of the Part 264 standards are also included within the Part 265 Interim Status Standards, the latter standards are the basis of the discussion below.

For this discussion, the requirements in the Interim Status Standards have been grouped into the following categories: Administrative and general technical requirements applicable to all facilities; groundwater monitoring; closure and post-closure, including financial requirements; and standards applicable to specific types of management facilities. Each will be discussed briefly below.

Administrative and general technical requirements include the following types of requirements: (1) administrative requirements such as notices, handling the manifest, recordkeeping and reporting, (2) general technical requirements including waste analysis, security, inspections, training, plans for preparedness and prevention of accidents, plans for contingencies and emergencies.

All hazardous wastes must be subject to these administrative requirements. They have been designed to cause a minimum of impact on the regulated community and still enable sufficient tracking of wastes and enforcement of the regulations. Any reduction in the requirements would seriously impair their usefulness to the Agency. These are already minimal requirements, as discussed in the background documents supporting them.

With respect to general technical requirements the Agency believes that the requirements are sufficiently flexible to accommodate differences in waste properties or levels of hazard. For example, waste analysis, inspections, training, preparedness and prevention, and contingency plans and emergency procedures all require a plan from the facility owner or operator which addresses his needs in each area. Thus, the plans can and should consider the type of waste being managed at the facility.

Groundwater monitoring is a major technical requirement in the Part 265 standards. As is true of other parts of the regulations, the groundwater monitoring requirements provide more flexibility than did the proposed regulations. For example, the owners or operators must first monitor for a set of indicators which will indicate whether a facility is leaking. If the facility is leaking, a more comprehensive ground-water assessment program must be initiated. Such a program is expected to involve monitoring for specific hazardous waste constituents. In addition owners or operators who know or assume that their facility is leaking may institute an alternative monitoring program that is based on the ground-water assessment program.

The Agency believes that this ground-water monitoring approach provides sufficient flexibility and careful sequential investigation for each facility. The owner or operator may also institute lesser monitoring if he can demonstrate that there is a low potential for migration of hazardous wastes from the facility to water supply wells or surface water.

Closure and post-closure requirements provide flexibility because the owner or operator prepares a closure plan which explains how the facility will be closed. The minimum requirements for closure derive from a general performance standard and the management specific standards (e.g. landfills, incinerators, etc), but these requirements also provide singificant flexibility. For example, landfill closure requirements specify that in developing the closure plan the owner or operator must consider the type of hazardous waste in the landfill, its expected mobility, and other site specific factors. The plan is to be directed toward three basic objectives: control of pollutant migration; control of surface water infiltration; and, prevention of erosion. Post-closure requirements relate closely to the factors considered in closure. In addition, the owner or operator may petition for a reduction in the length of the post-closure period.

The facility-specific standards incorporate several generic types of requirements. One is that they specify certain "good operating practices" that would be applicable to virtually any waste. For example, the standards for tanks specify that: "hazardous wastes or treatment reagents must not be placed in a tank if they could cause the tank to rupture, leak, corrode, or otherwise fail before the end of its intended life." Others are minimum requirements for waste analysis, inspection, and recordkeeping. The Agency believes that these are minimum good operating practices necessary for protection of human health and the environment.

The facility-specific standards contain some tailored requirements based on the type or class of hazard a waste presents. For example, there are specific requirements dealing with ignitable wastes, reactive wastes, incompatible wastes, and liquids. These are precisely the kind of tailored requirements that meet the objectives of a degree of hazard system.

Thus, the interim status standards combine certain requirements which must be considered minimum necessary practices regardless of the waste involved, and other requirements which provide significant flexibility for the owner or operator to tailor them to the waste and conditions involved.

Phase II Standards

The subsequent phase of the regulations, addressing the technical management requirements under Section 3004 of RCRA, will be designed to provide significant flexibility during the permitting process for specifying management requirements to meet specified performance standards. In fact, the Phase II standards are referred to in the preamble to these regulations as "best engineering judgment" regulations. EPA expects these standards to provide basic performance requirements and a set of relevant technical factors and, where appropriate, formulas.

The permitting official will apply engineering judgment in developing the permit requirements. This is the appropriate level to apply such judgment because it allows maximum flexibility to tailor the specific permit requirements based on waste specific and site specific knowledge. The Agency will issue reference documents to assist the permitting officials in tailoring final permit requirements.

Over time, as the Agency gains more knowledge about best management practices for specific wastes, the tailoring process can be factored into the regulations on a waste by waste or industry by industry basis. This will have the benefit of streamlining and speeding the permitting process.

Through this very flexible system of final regulations, combined with the flexibility already incorporated in the interim status standards, the Agency believes that the objective of tailoring will be met in an effective and comprehensive way.

3. Response to setting exemption levels for small quantities

Several commenters in responding to either degree of hazard or small quantity generator issues suggested using the degree of hazard of wastes as a means of establishing a quantity exclusion level below which the generator's waste would be subject to reduced (or no) Subtitle C requirements.

As explained in the preamble and background document for small quantity generators, the Agency considered hazard on a selective case by case basis in establishing very low exclusion levels (from 1 to 100 kg/mo) for some substances which are extremely hazardous. These levels are well below the general exclusion level of 1000 kg/mo. Thus, on a selective basis the Agency has considered hazard in setting administrative exclusions for small quantity generators.

Had it been feasible to develop a sophisticated degree of hazard system, the Agency might have been able to apply it to the small quantity generator issue. However, the Agency is satisfied that the approach to the small quantity issue which it has taken, i.e., a general exclusion coupled with case by case reductions in that exclusion, is reasonable and will be effective.

Appendix

During the comment period, the Agency received several hundred comments suggesting that the regulations incorporate a degree of hazard system. However, only a few commenters actually proposed a definitive of degree hazard system. This Appendix examines the 21 systems proposed (16 from industry and 5 from States) and provides the Agency's response to each.

The comments on these proposals should be viewed in the context of EPA's overall response to the degree of hazard issue, as stated in the preamble to the regulations in Parts 264 and 265 and in the main body of this background document. As expressed in those documents, EPA believes that the regulations just promulgated, along with the Phase II regulations to be promulgated in the Fall of 1980, will accomplish the objectives of a degree of hazard system. The Agency believes that the alternative regulatory approaches to achieve these objectives, including incorporation of flexibility in the management standards to allow evaluation of waste and site-specific conditions, will avoid the highly subjective judgments which EPA would have to make, and does not believe it could technically support, in order to rank wastes by degree of hazard and differentiate management requirements for each level of hazard. The responses in this Appendix to different proposed degree of hazard systems is intended primarily to illustrate the kinds of complexities associated with a degree of hazard system, and the aspects of these proposals which EPA would find difficult or impossible to technically justify in a national regulation. The response to each of the proposed systems, some of which are very complex, is not intended to be an exhaustive account of EPA's thinking and analysis, but represents a discussion of some of the major issues associated with each. It is intended to further illustrate the basis for the conclusions drawn in the preamble and body of this document regarding the feasibility and desirability of a degree of hazard system.

Specific Suggestions Provided by the Public for Defining Degree of Hazard

I. Degree of Hazard Systems Proposed by Commenters

1. Comments

One commenter suggested, in his initial submission, that at least three levels of hazard should be defined. In this initial submission, the commenter provided a very general and broad description of each of the three classes. However, in response to the Agency's request for additional information on this degree of hazard approach, the commenter expanded his scheme to five levels of hazard based on the Section 3001 hazard characteristics, (i.e., ignitability, corrosivity, reactivity, toxicity) and on certain other test results. More specifically, the commenter provided the following suggestions:

Class I - High Hazard

These are wastes which, if improperly handled, could present a high hazard to health or the environment, and which, therefore, require special care in storage, handling and disposal. Such wastes would be disposed of in the most secure RCRA §3004 facilities. Included in this class would be persistent, mutagenic, and high-to-moderate acutely toxic wastes, plus wastes which would present a high hazard to drinking water supplies.

Specific criteria for this class are:

1. Its extract fails the mutagenic activity test and fails a persistence test; or
2. Its extract is an organic material of the high acute toxicity; or

3. Its extract is an organic material of moderate acute toxicity, and fails the accumulation potential test and fails a persistence test; or

4. The extract contains any contaminant listed in §250.13(d) (of the proposed regulations) at concentrations greater than or equal to 1000 times the National Interim Primary Drinking Water Standard.

Class II - Moderate Hazard

This class includes wastes which could present a moderate degree of hazard to health or the environment if improperly handled, but which can be safely handled and disposed in a well designed and operated hazardous waste management facility. This class would include moderate or low toxicity wastes with unusually high accumulation potentials or persistence characteristics. Ignitable wastes, reactive wastes, and wastes posing moderate potential danger to drinking water sources would also fit into this class. Class II facilities would be subject to many of the same §3004 standards as Class I facilities, but in some respects, where appropriate, the degree of control would be somewhat less stringent.

Specific criteria for this class are:

1. Its extract fails the mutagenic activity test, but does not fail a persistence test; or

2. Its extract is an organic material of moderate acute toxicity and either a) fails the accumulation potential test, but does not fail a persistence test, or b) does

not fail the accumulation potential test, but fails a persistence test; or

3. Its extract is an organic material of low acute toxicity and fails the accumulation potential test and fails a persistence test; or
4. The extract contains any contaminant listed in 250.13(d) (of the proposed regulations) at concentrations greater than or equal to 300 and less than 1000 times the National Interim Primary Drinking Water Standard; or
5. It fails the ignitability characteristic; or
6. It fails the reactivity characteristic.

Class III - Low Hazard

This class would include those wastes which, although categorized as "hazardous", nonetheless represent only a minimal potential hazard to health or the environment. Included would be wastes of low toxicity, and nonaccumulative, non-persistent moderate toxicity wastes, as well as corrosive wastes and wastes of low potential hazard to drinking water.

Specific criteria for this class are:

1. Its extract is an organic material of moderate acute toxicity but does not fail the accumulation potential test and also does not fail a persistence test; or
2. Its extract is an organic material of low acute toxicity and a) fails the accumulation potential test and passes a persistence test, or b) passes the accumulation potential test; or

3. The extract contains any contaminant listed in 250.13(d) (of the proposed regulations) at concentrations greater than or equal to 100 times, but less than 300 times, the National Interim Primary Drinking Water Standard; or

4. It fails the corrosive characteristic.

Class IV - Special Wastes

These wastes which were defined by EPA as special wastes in the proposed regulations i.e., wastes generated in large volumes but which have low hazard or unique properties).

Class V - Radioactive and Infectious Wastes

These wastes be would be designated in "special" categories, not in the sense of being high volume or low hazard, but rather as needing special consideration for proper disposal.

Assumptions and Premises

1. Only the characteristic and properties set forth in the proposed RCRA Section 3001 regulations were utilized in the classification system. This includes the Section 250.13 characteristics plus application of certain Section 250.14-15 listing/delisting properties for listed wastes. Additional waste characteristics considered in EPA's Section 3001 ANPR were not used.
2. This hazard classification system does not affect the definition of "hazardous" waste under Section 3001, except as provided in earlier comments. Any waste categorized as "hazardous" by virtue of RCRA Section 3001 characteristics would be fitted into one of four

hazard classes (Class I, Class II, Class III, or "Special").

3. Toxicity limits as defined in the classification system are shown in Table 1.

Management Standards

The commenter proposes a three-tier classification system under which hazardous waste disposal facilities would be designed and operated on the basis of standards designed to achieve a degree of protection consistent with degree of hazard potentially presented by the wastes being disposed. The system does not significantly alter the boundaries of EPA's proposed "hazardous waste" definition; rather, this system further classifies hazardous wastes so that they may be disposed of in an adequate, but not excessively stringent, manner. The facility classification scheme would result in facility utilization as follows:

Class I Facilities

Class I facilities would be designed and operated to allow safe disposal of the most hazardous waste. These wastes, which because of their toxicity and accumulation/persistence properties, require a high degree of protection in handling and disposal, and a high degree of protection against significant release into the environment. Facilities receiving and disposing of Class I hazardous wastes would be basically be required to be in compliance with the full scope of Section 3004 regulations.

Class II Facilties

Class II facilities would be designed and oprated to allow safe disposal of wastes which present a lesser degree of potential

Table 1

RATIO: ACTUAL CONCENTRATION/CRITICAL CONCENTRATION

Component LD50 mg/kg (rat or mouse)	<100	>10-≤100	≥1-≤10
≤50	High Acute Toxic	High Acute Toxic	High Acute Toxic
>50-<500	High Acute Toxic	Moderate Acute Toxic	Moderate Acute Toxic
≥500-<3000	Moderate Acute Toxic	Moderate Acute Toxic	Low Acute Toxic
≥3000-≤5000	Low Acute Toxic	Low Acute Toxic	Low Acute Toxic

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acute or chronic hazard by virtue of toxicity and accumulation/persistence properties. The criteria for differentiating Class I and Class II wastes, and the appropriate facility standards are based on the knowledge and experience of certain industrial companies. While there is a valid "break point" for defining "high hazard" and "moderate hazard", the proposed Class I and Class II facility standards proposed herein are only slightly different. Class II wastes, with potential hazard less than those in Class I, would still be stringently controlled over a long term.

Class III Facilities

Class III facilities would be designed and operated to allow safe disposal of wastes representing relatively low potential hazards, or which will not persist in the environment as hazardous for appreciable periods of time. This category would include inorganic wastes that would not be a serious threat to drinking water sources, as measured by the drinking water comparison characteristics. Also included would be materials such as relatively inert, low toxicity organic "tars". Class III wastes will represent a low level of hazard during handling and disposal operations, and, once landfilled, will be very unlikely to endanger surface or groundwater. Consequently, Class III facility standards are proposed that are based on good engineering practice and are aimed at minimizing release of the waste to the environment.

In addition to these generic descriptions, the commenter provided specific suggestions for each of the three classes covering all of the major management requirements in the proposed regulations. Examples of those specific suggestions are provided below:

Site Selection Criteria (§250.43-1)

Class I Facilities

1. Protect against 100-yr. flood--except incinerators, storage facilities and landfarms, which should utilize appropriate property protection measures.
2. No location in a sole source aquifer recharge zone.
3. Active portions of the facility 200 ft. from bordering non-industrial property lines, and 50 ft. from bordering industrial property lines.

Class II Facilities

1. Flood protection as defined for Class I.
2. No location within a sole source aquifer recharge zone.
3. Active portions of the facility 100 ft. from the boundary of non-industrial property lines and 50 ft. from bordering industrial property lines.

Class III Facilities

1. Case-by-case decision on flood protection.
2. Protect against endangerment of usable aquifer.
3. Distance from active portion to facility boundary as necessary to allow for groundwater monitoring.

Financial Requirements (§250.43-9(b) (1))

Class I Facilities

$2 million liability protection

Class II Facilities

$1 million liability protection.

Class III Facilities

$100,000 liability protection.

Incinerators (§250.44-2)

Class I Facilities

Specified destruction efficiency (DE), combustion efficiency (CE), and emission monitoring.

Class II and III Facilities

No DE, CE or monitoring requirements under RCRA. Subject incinerators only to regulation under the Clean Air Act State Implementation Plans.

Landfills (250.45-2)

Class I Facilities

1. Bottom of the liner 2 ft. above the historical high water table.
2. Locate at least 500 ft. from any functioning public water supply (groundwater sources only).
3. Liner design - require 4 ft. in-place soil barrier with 1 x 10^{-7} cm/sec. permeability (250.45-2(b)(11)).
4. Alternate Design I (§250.45-2(b)(13)(i)) - 3 ft. soil liner of 1 x 10^{-7} cm/sec. permeability, with leachate collection and removal system.
5. Closure as proposed.

Class II Facilities

1. Bottom of the liner 2 ft. above the historical high water table.
2. Locate at least 500 ft. from any functioning public water supply (groundwater sources only).

3. Liner design - require 3 ft. in-place soil barrier with 1×10^{-7} cm./sec. permeability (§250.45-2(b)(11)).
4. Alternate Design I (§250.45-2(b)(13)(i)) - 2 ft. soil liner of 1×10^{-7} cm/sec. permeability, with leachate collection.
5. Closure as proposed.

Class III Facilities

1. No restriction on distance between bottom of liner and historical high water table.
2. Locate at least 200 ft. from any functioning public water supply (groundwater sources only).
3. Liner design - require 3 ft. in-place soil barrier with 1×10^{-6} cm/sec. permeability (§250.45-2(b)(11)).
4. Alternate Design I (§250.45-2(b)(13)(i)) - 2 ft. soil liner of 1×10^{-6} cm/sec. permeability - without leachate collection.
5. Closure plans determined on case-by-case basis.

Discussion

The degree of hazard system submitted by this commenter is one of the more complete and carefully structured proposals received. It includes both a detailed scheme for ranking wastes by degree of hazard and specific management standards for each of the levels provided. However, the Agency finds that this system has certain significant shortcomings which make its adoption undesirable or infeasible.

(1) Rationale for the toxicity limits and hazard ranking of characteristics

EPA would find it difficult to justify and technically support the toxicity rankings and overall hazard rankings suggested by the commenter. The commenter did not discuss the rationale for these rankings in other than very general terms, e.g., wastes in Class I "require a high degree of protection in handling and disposal, and a high degree of protection against release into the environment". The Agency recognizes that determinations of this type often require application of best scientific judgment, because data may not be precise or complete. However, the Agency noted a number of concerns with the rankings, and technical support would require a great deal more information. In some cases the rankings are simply incorrect in the Agency's view. A few examples will illustrate this point.

A general concern is that it appeared from the commenter's discussion that the rankings were based primarily on potential damages through leaching from a land disposal facility. Thus, potential damages from improper handling or from other types of management were not obvious in the rankings. As a result ignitable and reactive wastes were placed in the moderate hazard category, and corrosive wastes were placed in the low hazard category. EPA's damage files ocntain numerous cases of substantial damage to persons and the environment from these wastes. That is why the final Subtitle C regulations place special restrictions on the handling of ignitable and reactive wastes in management facilities. These standards focus on the type or class of hazard presented, rather than an essentially arbitrary degree of hazard ranking.

Other hazard rankings would be similarly difficult to justify. An example in the commenters proposal placed a waste (2-Naphthylamine), which is a known human carcinogen, in the "moderate" hazard category, while another waste (2,4-Dinitrophenol), which has a high acute toxicity under the commenters proposed limits, would be a "high" hazard waste. The Agency does not know how it would justify this determination if the proposed system were adopted. For example, in the proposed management standards the commenter proposed no destruction, emission or other standards beyond Clean Air Act requirements for incineration of moderate hazard wastes. The potential for release of the known carcinogen into the air through incineration would seem to be quite high. How then, could this waste be considered a moderate hazard?

In a slightly more general vein, the Agency noted that any waste of "high" acute toxicity would be in the "high hazard" category while a "moderate" acute toxic which is also bioaccumulative or persistent would be ranked as a "moderate hazard". Again, the Agency can see no justification for this determination, since depending on the management situation, either could cause substantial human health impacts.

The toxicity ranking itself, which is used in the overall hazard ranking, would be difficult to justify. The limits proposed for the three levels of toxicity are not inherently unreasonable, but they also have no obvious justification. A review of the other comments reveals numerous other, quite different, toxicity rankings. For example, various commenters recommended different oral toxicity limits for "high", "moderate", or "low" hazard. Some also recommended human inhalation toxicity and dermal toxicity in addition to oral toxicity. A few commenters recommended aquatic toxicity or toxicity to plants in addition to human toxicity. Some did not include concentration in the toxicity rankings as did this commenter, or if they did, different limits were suggested. And some recommended either more or fewer levels of toxicity than the three which this commenter suggested.

The justification for any of these proposed toxicity or overall hazard rankings must be linked to potential human health and environmental impacts under mismanagement scenarios. If this could be done, the management requirements to avoid these damages could be tailored to the various hazard levels. However, this commenter, as well as other commenters, did not adequately make this link to exposure and risk to human health and the environment either in justifying the proposed rankings or in the suggested management requirements for each hazard level defined. As stated elsewhere in this document, the Agency knows of no way to appropriately make these links in a comprehensive degree of hazard ranking.

(2) Intrinsic hazard v.s. exposure

As stated in the body of this report, risk to human health depends on both the intrinsic hazard of a waste (e.g., its relative toxicity) and on exposure. Exposure is dependent on a number of variables, including waste quantity, concentration, persistence, biodegradability or attenuation in the soil, and various site specific factors such depth to groundwater, soil type, etc. The commenter has attempted to consider exposure and risk as well as intrinsic hazard by ranking wastes based on concentration rather than relative toxicity alone, and by also considering persistence and bioaccumulativity in the hazard ranking. The approach is a step in the right direction. However, it is inadequate in that potential exposure also relates to numerous site specific factors which cannot be adequately considered in a national hazard ranking. For example, a waste ranked in the "high hazard" class which is managed in a landfill in an area of low rainfall, very deep groundwater, and low population density might require *less* stringent permit conditions to adequately protect public health than a "moderately hazardous" waste landfilled in an area with high rainfall, high water table, and a nearby aquifer that is a primary drinking water supply. Thus, the site specific conditions have a more significant impact on exposure and risk than the commenter's suggested hazard ranking. The Agency's planned Phase II management standards will provide the flexibility to consider such factors on a case-by-case basis.

(3) Management Standards

The commenter has proposed specific management requirements for each of the three levels of hazard defined. However, EPA does not concur with the distinctions made. A few examples will illustrate the Agency's disagreement. For incineration of "high hazard" wastes the commenter proposed certain standards for destruction efficiency, combustion efficiency, and emission monitoring. For "moderate hazard" wastes the commenter suggested no requirements at all beyond those already applicable under the Clean Air Act. Under the commenter's scheme moderately hazardous wastes would include carcinogens, and bioaccumulation or persistent "moderate" toxics. EPA sees no rationale for not regulating destruction efficiency or emissions from incineration of such wastes. Mismanagement and damage to human health would appear highly probable in the absence of incinerator performance or operating standards.

The suggested land disposal standards for "highly" and "moderately" hazardous wastes differ only in the liner requirements, i.e., 3 feet of in-place soil for moderately hazardous waste and 4 feet for highly hazardous waste.

The significance of this one foot distinction as it relates to the many and varied properties of the wastes included in the hazard classes and to the protection of public health, is totally unclear, and in EPA's view is arbitrary. Other factors are more important in controlling emissions of these wastes from a landfill and their ultimate risk to public health. The factors include hydrogeology, cover design, depth to groundwater, soil type, etc. Furthermore, the fact that a waste is persistent or bioaccumulative may be more important than its toxicity level in some circumstances regarding risk to human health.

Many similar examples could be provided illustrating the problems which EPA sees in trying to tailor management standards to defined degrees of hazard, rather than to waste properties or site conditions. The Agency believes that the Phase I regulations (and the Phase II regulations when promulgated) will provide for flexibility to tailor management requirements on a case-by-case basis during the permitting process, including consideration of waste properties or type of hazard. This will provide a far better approach to tailoring than making extremely difficult and subjective management distinctions based on degree of hazard.

2. Comment

One commenter suggested a six-tier degree of hazard concept. In this system exposure is a defined function of entry (form, quantity) and availability (movement, stability, bioconcentration), while effect is defined in terms of toxicity, carcinogenicity, mutagenicity or teratogenicity. The first step in developing the classification system was to consider quantity. A hierarchy of control levels was constructed for the waste leachate in water as shown in Table 2. This assumption was made assuming that a toxic compnent is disposed of through a landfill, is leached, then attenuated in surrounding soil, and finally diluted into a natural water. These control levels in water were assigned on the basis of known mammalian and aquatic toxicity ranges for water-borne components (LD50 toxicity values for rats; LC50

Table 2

Exempt Quantities for Hazard Classification

Hazard Category	Control Level of Toxic Component in Water, mg/L	Exempt Rate of Generation of Toxic Component, kg/mo
A	<0.00001	<1*
B	.00001-<0.001	<10
C	.001-<0.1	<100
D	.1-<10	<1000
E	10-<1000	<10,000
F	≥1000	<100,000

*Certain uniquely toxic wastes may be hazardous at lower rates of generation toxicity values for fish or other aquatic species, as shown in Table 3). This categorization was patterned after similar schemes proposed by the Intergovernmental Maritime Consultive Organization of the U.N. (IMCO), the EPA spill regulations (Sec. 311 of the Clean Water Act), the pesticide regulations (under FIFRA), and a classification scheme developed by the State of Washington, as well as others by the NAS, AIBS, and ASTM.

The rate of generation to be exempted from regulation as a hazardous waste was then assigned to each hazard category. A quantity of 1 kg/mo or greater of waste in Category A, 10 kg/mo in B, 100 kg/mo in C, or 1000 kg/mo in E would be subject to management as a hazardous waste. A total quantity of 10,000 kg/mo or greater of Category E would be allowed into a segregated (monolandfill) facility. Category F waste was classified as special waste, i.e., a high volume, low hazard waste which would require disposal under minimal guidelines. The stairstep classification according to quantity is shown graphically in Figure 1. All wastes in all Categories A-F equal to or greater than the specified rates of generation would be considered hazardous and would require disposal in hazardous waste management facilities (RCRA Section 3004 facilities). All wastes in all Categories A-F less than the specified rates of generation would be considered non-hazardous for purposes of regulation and require disposal in solid waste management facilities (RCRA Section 4004 facilities).

The second step in developing an alternative classification was to consider the concentration of a hazardous waste present

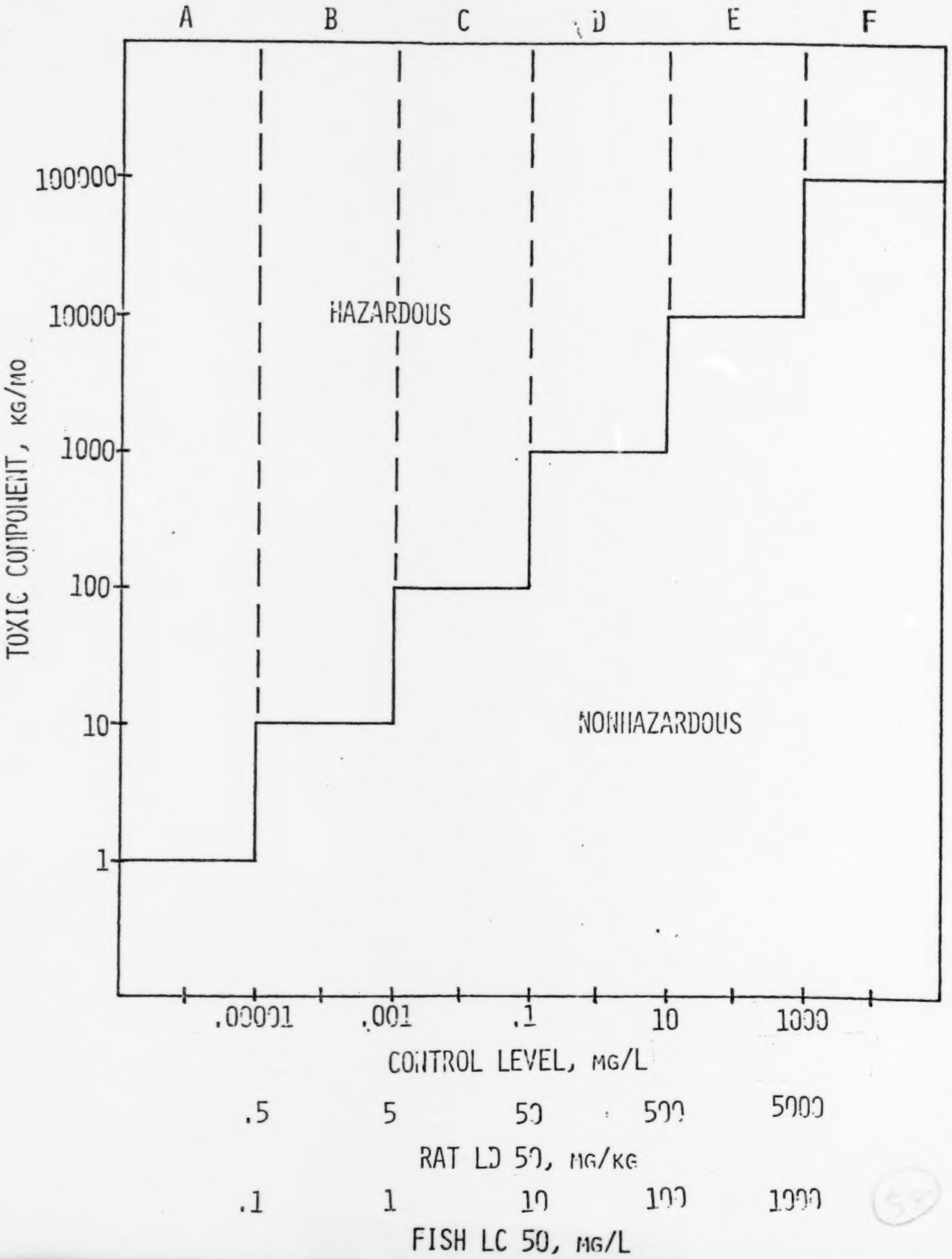
Table 3

Mammalian and Aquatic Toxicity Ranges

Hazard Category	Mammalian Toxicity Rat LD50, mg/kg	Aquatic Toxicity Fish LC50, mg/L
A	<.5	<.1
B	.5-5	.1-1
C	5-50	1-10
D	50-500	10-100
E	500-5000	100-1000
F	>5000	>1000

FIGURE 1

WASTE GENERATION AND CONTROL LEVEL



in a total (hazardous & non-hazardous) waste as shown in Table 4. Establishment of exempt concentrations for the various waste categories would avoid the overclassification of dilute wastes as hazardous unless the quantity of hazardous waste in the total waste exceeds the rate of generation previously defined.

This results in the coupling of only significant quantities and concentrations upon degree of hazard. This approach is similar to the one developed by the State of Washington.*

At 100% concentrations, the total waste is entirely hazardous waste at quantities ranging from 1 to 100,000 kg which designate the six cateogires (A-F). To be included in the hazardous waste management system, for example, a generator would have to generate at least 100 kg/mo of waste in Cateogry C at a 100% concentration or 1000 kg/mo at 10% or 10,000 kg/mo at 0.1% by weight to require disposal within a 3004 facility. Otherwise the waste could be disposed of adequately within a 4004 facility. Mixtures would be handled by summing the quantities within categories and then weighting among categories.

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*Mehlhaff, L. C., Cook, T., and Knudson, J., A Quantitative Approach to Classification of Hazardous Waste, 1979 Sanitation Industry Yearbook, pp. 70, 72, 76, 78, 80, 82, 82, and

Table 4

Exempt Concentrations for Hazard Classification

Hazard Category	Quantity of Toxic Component in Total Waste kg/100,000 kg	Exempt Concentration of Toxic Component in Total Waste, % by Weight
A	1	0.001
B	10	0.01
C	100	0.1
D	1000	1.0
E	10,000	10.0
F	100,000	100.0

To complete the description of hazard, one is further required to couple characteristics of effect, such as toxicity, with those of exposure, such as migration potential, stability (persistence), and bioaccumulation (bioconcentration). This can be done by screening tests for toxicity, bioaccumulation, and persistence. The sequence of tests is conducted partly in parallel and partly in series. The results are interpreted as follows:

1. A waste is first tested for migration potential by applying a suitable leaching test.
2. The leachate is then tested for toxicity, bioaccumulation, and persistence as appropriate.
3. If persistence and/or bioaccumulation are positive, and toxicity is also positive, the waste is hazardous.
4. If toxicity is negative, the waste is non-hazardous even if both persistence and bioaccumulation are positive.
5. A waste is not hazardous unless at least one effect (toxicity) and one exposure (bioaccumulation or persistence) test are positive (i.e., a single positive for any of these three tests is insufficient to declare hazard).

Various hierarchies of degree of effect can be established for characteristics of effect other than toxicity which would fit into the six categories (A-F). Examples might inlcude ranges of acidities and flash points. Similarly, various hierarchies of degree of exposure can also be established for bioaccumulation and persistence. Examples would be ranges of partition factors and half-lives, respectively.

The influences of bioaccumulation and persistence upon toxicity are shown in Figure 2. If a toxic waste is bioaccumulative and/or persistent, the stairsteps are lowered. If a toxic waste is less bioaccumulative and/or less persistent, the stairsteps are raised. It is possible for some wastes to lose essentially all of their toxicity through degradation and for other to intensify their toxicity through bioaccumulation. Wastes in one category also could be transformed to another category. Characteristics of exposure, therefore, must be considered carefully. The ranges for these characteristics are shown only in qualitative terms in Figure 2 (dashed horizontal lines) and are not intended for regulatory guidance.

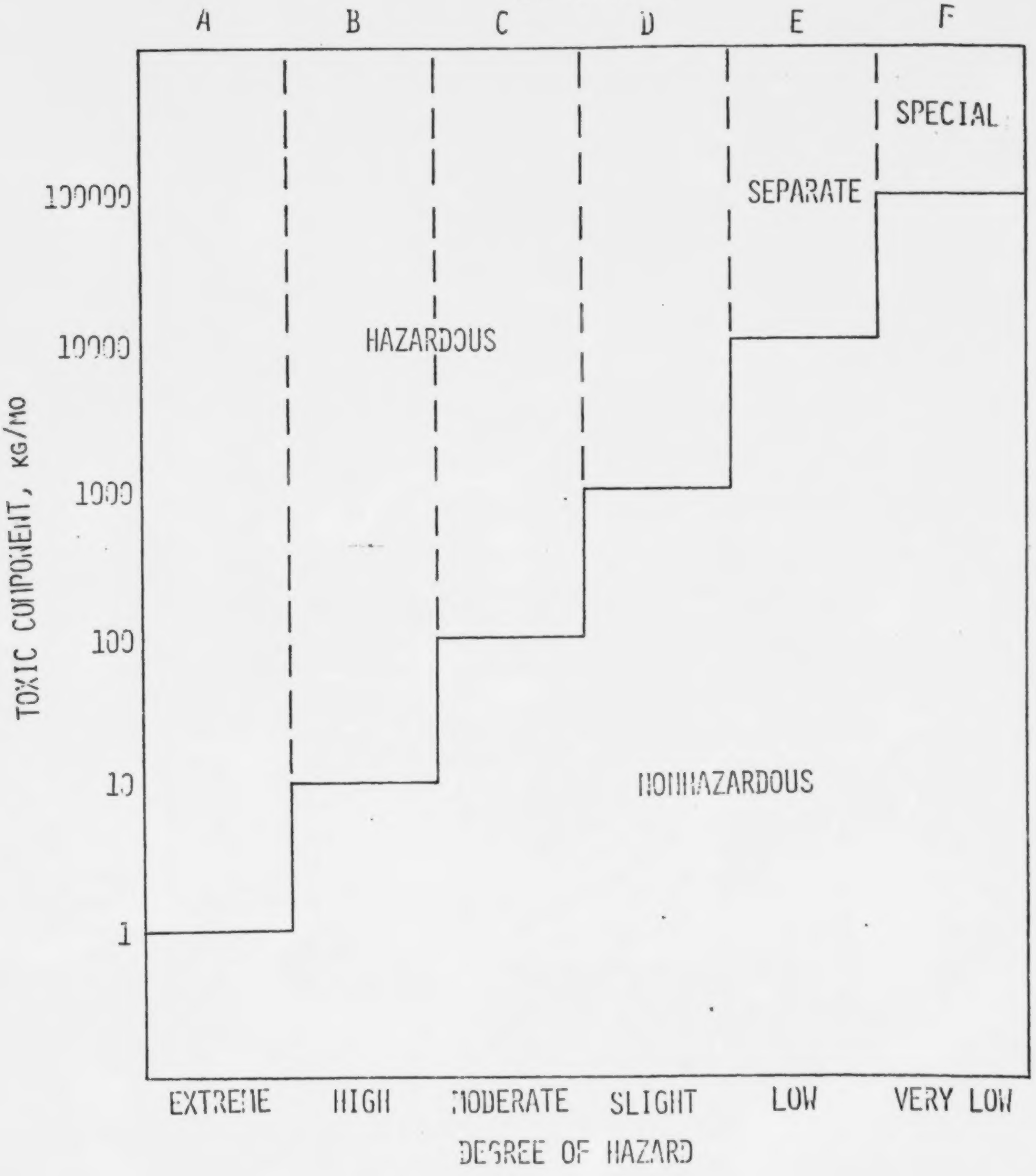
Discussion

The suggested approach submitted by the commenter is quite similar to the system now in existence in the State of Washington, which is described later in this document. The Agency believes that some interesting and innovative ideas have been presented by the commenter. In developing its Phase II regulations, the Agency may further consider some of these ideas that may be applicable to class of hazard distinctions. However, the system as proposed has a number of deficiencies that make it an unacceptable degree of hazard system for a national regulation.

(1) The approach addresses only one characteristic - toxicity. There is no indication of how ignitable, reactive, corrosive and other properties would be ranked. Thus, it is incomplete.

FIGURE 2

CLASSIFICATION OF SOLID WASTES BY TOXICITY



(2) The rationale for establishing six levels of toxicity or for the limits defining each was not clear to EPA. The commenter did submit general background data (primarily journal articles) on determination of toxicity levels, fate of chemicals in the environment, and impact of toxicity on public health and the environment, but this information did not address the specific toxicity ranking suggested. It did appear, however, that the ranking assumed management by land disposal only. EPA could not defend a toxicity ranking based only on one management alternative.

(3) The approach does not explain what differences in management requirements would be associated with each level of hazard. Although a journal article was provided related to four classes of land disposal, it was not clear how these classes were to be matched with the six proposed toxicity levels. Furthermore, management alternatives other than land disposal were not addressed.

(4) The approach would require extensive waste analysis, including analysis for persistence and bioaccumulation, and would greatly increase the testing cost to generators.

(5) The hazard ranking is intended to address both intrinsic hazard of a waste, and potential exposure. It does accomplish this to a limited extent. However, since it looks at exposure pathways related to land disposal only, it is incomplete. Further, site specific factors

affect potential exposure, such as the amount of waste, presence of other wastes, hydrogeology, soil attenuation, biodegradation and dilution, proximity to populations, etc. These factors cannot be considered in a national hazard ranking. This is one reason the Agency believes that a preferable way to tailor management standards is to provide flexibility for tailoring during the permitting process when site-specific factors can be considered. (See discussion, comment #1.)

3. Comment

One commenter suggested a classification system based on an integrated appraisal of the relationships betweeen (1) the degree of hazard of a waste, (2) the characteristics and location of the disposal facility or containment method used, and (3) the potential fate of the hazardous waste upon treatment or disposal The scheme is best explained by reference to Figures 3 through 10 which follow.

Figure 3

Illustrative Characteristics to be Taken into Account in a Hazardous Waste Treatment/Disposal Classification System

I. Hazard Factors

  A. Potential for Human Harm

    1. Ingestion Hazard

    2. Inhalation Hazard

  B. Potential for Environmental Harm

    1. Toxicity to Fish

II. Hazard Modification Factors

  A. Bioaccumulation

  B. Biodegradation

    1. Aerobic

    2. Anaerobic

  C. Potential for Transfer

    1. Adsorption to Soil

    2. Water Solubility

    3. Volatility

III. Applicability of Incineration

  A. Under Best Available Conditions (equivalent to T=1200°C, R.T.=2 seconds and 3% excess oxygen)

  B. Under Conditions Typical for Refuse Incineration and Boilers

IV. Handling Properties

  A. Ignitability

  B. Corrosivity

  C. Reactivity

Figure 4

Illustrative Hazard Values and Other Properties for Various Waste Characteristics

Waste Characteristics	Hazard, Hazard Reduction and Hazard Control Criteria	Hazard Value	Incineration Properties	Handling Properties
I. Potential for Human and/or Environmental Harm				
A. Human				
1. Ingestion Hazard a) Below Minimum		0		
b) Minimum to Moderate	(Criteria would be established for each hazard, hazard reduction, and hazard control range of each waste characteristic.	+1		
c) Moderate to Severe		+2		
2. Inhalation Hazard a) Below Minimum		0		
b) Minimum to Moderate		+1		
c) Moderate to Severe		+2		
B. Environmental				
1. Toxicity to Fish a) Below Minimum		0		
b) Minimum to Moderate		+1		
c) Moderate to Severe		+2		
II. Hazard Modification Factors				
A. Bioaccumulation				
1. Below Minimum		0		
2. Minimum to Moderate		+1		
3. Moderate to Severe		+2		
B. Biodegradation				
1. Aerobic Conditions a) No Effect		0		
b) Moderate		-1		
c) Extensive		-2		
2. Anaerobic Conditions a) No Effect		0		
b) Moderate		-1		
c) Extensive		-2		
C. Transfer Potential				
1. Soil Adsorption a) Low		0		
b) Moderate		-1		
c) Extensive		-2		
2. Water Solubility a) Moderate		0		
b) Low		-1		
3. Volatility a) High		+1		
b) Moderate		0		
c) Low		-1		

Figure 4 (Continued)

Waste Characteristics	Hazard, Hazard Reduction and Hazard Control Criteria	Hazard Value	Incineration Properties	Handling Properties
III. Applicability of Incineration				
a) Unacceptable			a	
b) Best Available Conditions			b	
c) Refuse Conditions			c	
IV. Handling Properties				
A. Ignitability				
1. Below Minimum				a
2. Minimum to Moderate				b
3. Moderate to Severe				c
B. Corrosivity				
1. Below Minimum				a
2. Minimum to Moderate				b
3. Moderate to Severe				c
C. Reactivity				
1. Below Minimum				a
2. Minimum to Moderate				b
3. Moderate to Severe				c

Figure 5

Treatment/Disposal Facility Description and Symbol Designation

Description	Designation
Incineration at T=1200°C, R.T. = 2 seconds residence, and 3% excess oxygen, or at specific combustion efficiency (Best Available)	I_{BA}
Incineration meeting Clean Air Act emission standards for garbage and refuse or power generation	I_R
Landfill with best available leacheate control per Section 250.45-2	L_{BA}
Landfill at sites where groundwater pollution potential is minimal because of absence of groundwater, remoteness of potential surfacing, absence of usable groundwater, etc.	L_{NG}
Landfill per standards for municipal garbage and refuse, Section 3008 regulations	L_R
Landfarming	L_F

Figure 6

Illustrative Minimum Reportable Quantities for Different Hazard Values

Hazard Value	Potential for Human and/or Environmental Harm-Subtotal Hazard Value	Reportable Quantity* (Pounds)
at least one 2	5 - 6	a
	3 - 4	b
	2	c
no 2's	3	d
	2	e
	1	f

* $a < b < c < d < e < f$

Figure 7

Illustrative Format for Listing Hazardous Waste Characteristics

Waste Material	Hazard Values				Reportable Quantity	Hazard Modification Values							Net Hazard Value	Incineration Properties	Approved Treatment and Disposal Methods	Handling Properties		
	Ingestion	Inhalation	Toxicity to Fish	Subtotal		Bioaccumulation	Aerobic Biodegradation	Anaerobic Biodegradation	Adsorption	Water Solubility	Volatility	Subtotal				Ignitability	Corrosivity	Reactivity

Figure 8

Waste Classification and Treatment/Disposal Decision Tree - Part 1

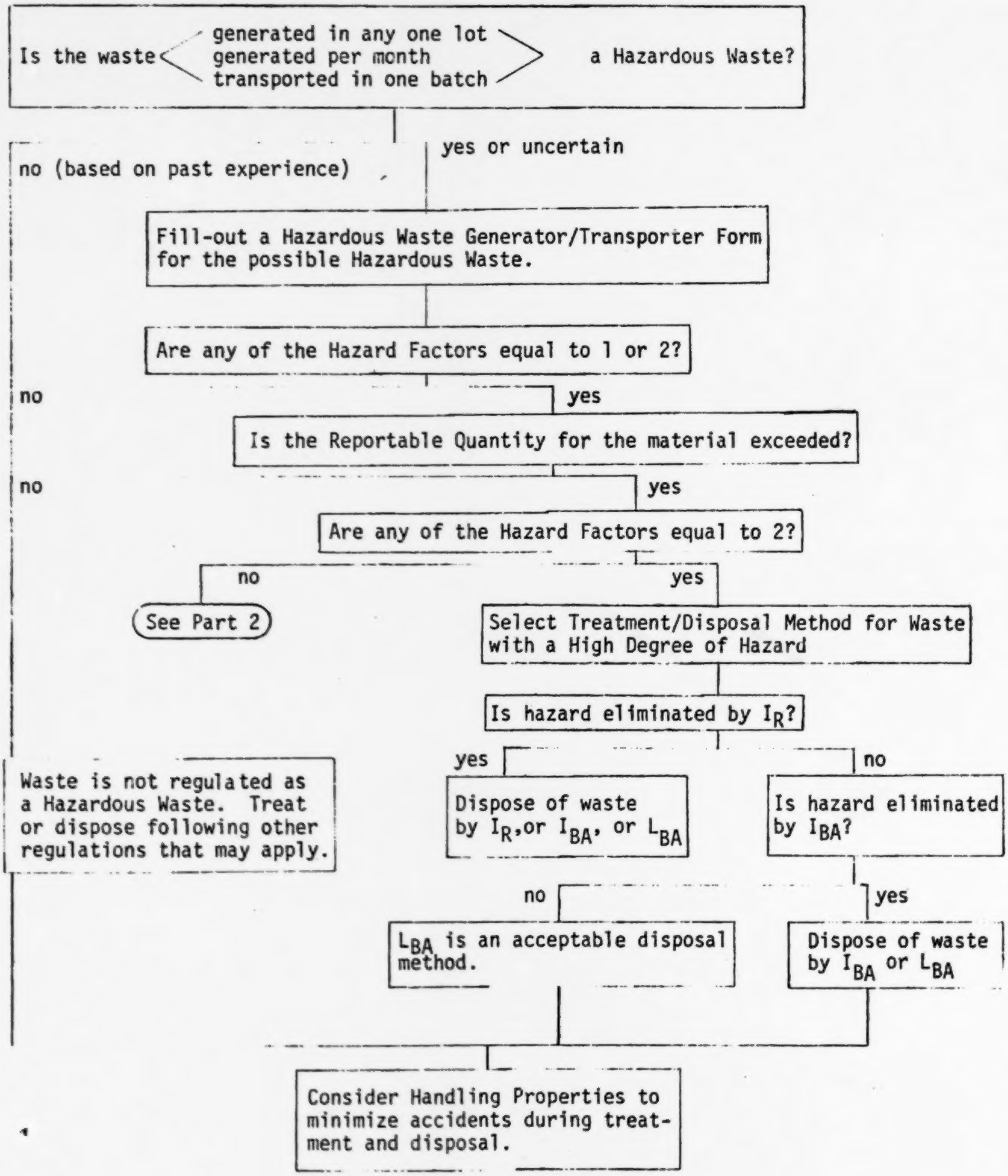

Is the waste generated in any one lot / generated per month / transported in one batch a Hazardous Waste?
no (based on past experience)
yes or uncertain
Fill-out a Hazardous Waste Generator/Transporter Form for the possible Hazardous Waste.
Are any of the Hazard Factors equal to 1 or 2?
no
yes
Is the Reportable Quantity for the material exceeded?
no
yes
Are any of the Hazard Factors equal to 2?
no
yes
See Part 2
Select Treatment/Disposal Method for Waste with a High Degree of Hazard
Is hazard eliminated by I_R?
yes
no
Waste is not regulated as a Hazardous Waste. Treat or dispose following other regulations that may apply.
Dispose of waste by I_R, or I_{BA}, or L_{BA}
Is hazard eliminated by I_{BA}?
no
yes
L_{BA} is an acceptable disposal method.
Dispose of waste by I_{BA} or L_{BA}
Consider Handling Properties to minimize accidents during treatment and disposal.

Figure 9

Waste Classification and Treatment/Disposal Decision Tree - Part 2

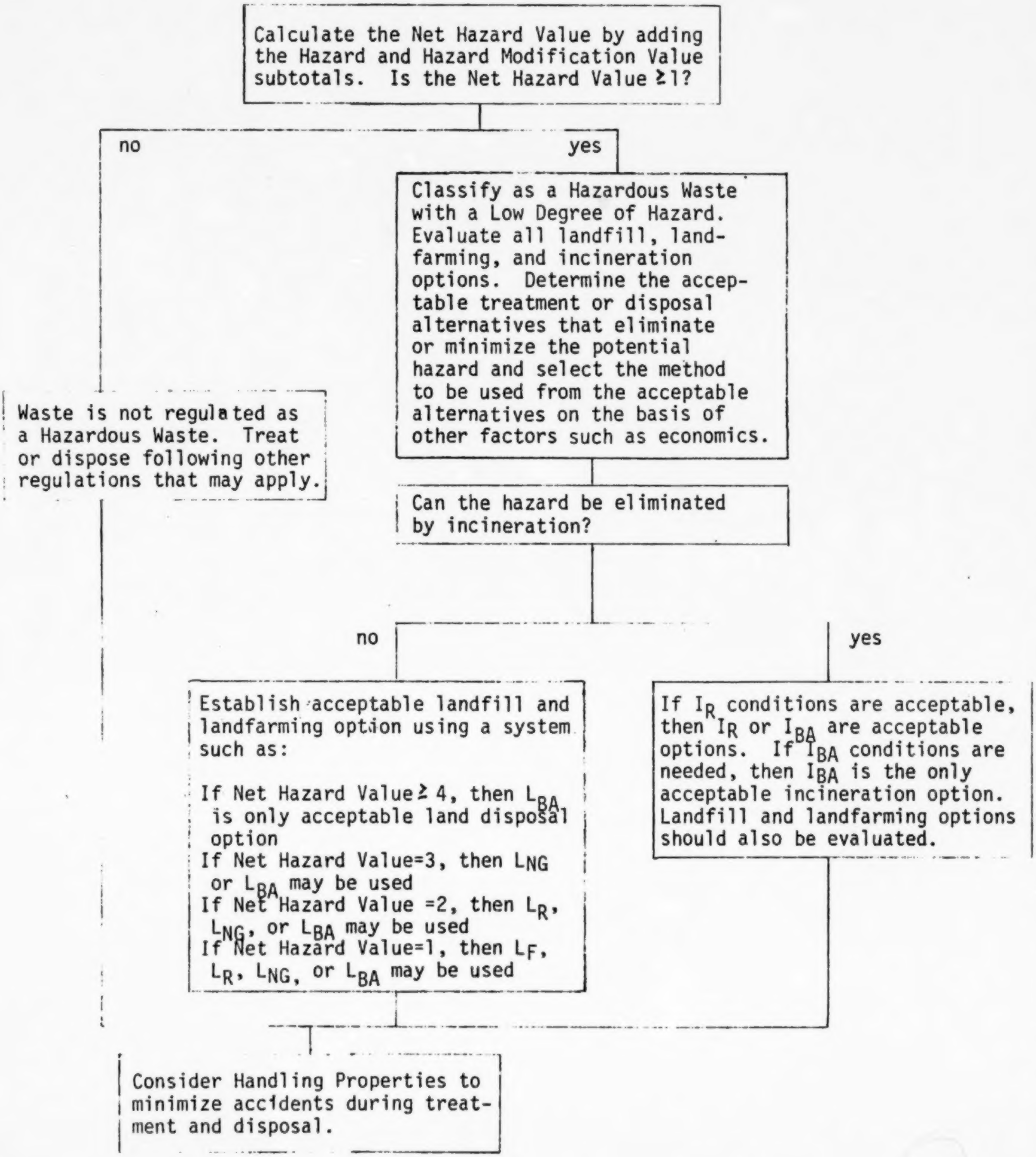

Calculate the Net Hazard Value by adding the Hazard and Hazard Modification Value subtotals. Is the Net Hazard Value ≥ 1?
no
yes
Classify as a Hazardous Waste with a Low Degree of Hazard. Evaluate all landfill, landfarming, and incineration options. Determine the acceptable treatment or disposal alternatives that eliminate or minimize the potential hazard and select the method to be used from the acceptable alternatives on the basis of other factors such as economics.
Waste is not regulated as a Hazardous Waste. Treat or dispose following other regulations that may apply.
Can the hazard be eliminated by incineration?
no
yes
Establish acceptable landfill and landfarming option using a system such as:
If Net Hazard Value ≥ 4, then L_{BA} is only acceptable land disposal option
If Net Hazard Value=3, then L_{NG} or L_{BA} may be used
If Net Hazard Value =2, then L_R, L_{NG}, or L_{BA} may be used
If Net Hazard Value=1, then L_F, L_R, L_{NG}, or L_{BA} may be used
If I_R conditions are acceptable, then I_R or I_{BA} are acceptable options. If I_{BA} conditions are needed, then I_{BA} is the only acceptable incineration option. Landfill and landfarming options should also be evaluated.
Consider Handling Properties to minimize accidents during treatment and disposal.

Figure 10

Illustrative Hazardous Waste Classification and Treatment/Disposal Form

Generator/Transporter ____________________________________
Waste ____
Possible Hazardous Constituent ____

A. Enter the appropriate values from a listing of Hazardous Waste Characteristics or after conducting suitable tests, etc.

		Waste		Hazardous Constituent	
		Result from List or Testing	Hazard Value	Result from List or Testing	Hazard Value
Hazard Factors	Ingestion				
	Inhalation				
	Fish Toxicity				
	Sub-total				
Reportable Quantity	Reportable Quantity				
	Amount in Waste-Estimated - Actual				

If any of the Hazard Values = 1 or 2, and the Reportable Quantity is exceeded go to B.

If none of the Hazard Values = 1 or 2, or the Reportable Quantity is not exceeded, go to H.

B. Incineration Properties

I_R acceptable

I_{BA} acceptable

Unacceptable

C. If any of the Hazard Values = 2, go to D.

If none of the Hazard Values = 2, go to E.

D. Classify as a waste with a High Degree of Hazard (Step 1).

If incineration is acceptable, I_R should be considered. If I_R is acceptable the choice between I_{BA} and I_R depends on hazard elimination, economics, etc. If I_R is unacceptable, I_{BA} should be considered.

If incineration is not acceptable, L_{BA} should be selected.

Go to J.

Figure 10 (Continued)

	Waste		Hazardous Constituent	
	Result from List or Testing	Hazard Value	Result from List or Testing	Hazard Value
E. Hazard Modification Factors				
Bioaccumulation				
Biodegradation				
- Aerobic				
- Anaerobic				
Transfer Properties				
- Soil Adsorption				
- Water Solubility				
- Volatility				
Sub-total				
Net Hazard Value				

The Net Hazard Value = the total of the Hazard Factor and Hazard Modification Factor sub-totals.

If the Net Hazard Value ≥ 1, go to F.

F. Classify as a waste with a Low Degree of Hazard (Step 1).

Consider all of the incineration, landfill and landfarming options making the selection based on hazard elimination, economics, etc.

Go to G.

G. If I_{BA} is needed, then I_{BA} is a possible selection.

If I_R is acceptable, then I_R or I_{BA} are possible options.

If Net Hazard Value ≥ 4, then L_{BA} is a possible selection.
=3, then L_{NG} or L_{BA} are possible selections.
=2, then L_R, L_{NG} or L_{BA} are possible selections.
=1, then L_F, L_R, L_{NG} or L_{BA} are possible selections.

H. Waste is not regarded as a Hazardous Waste.

Go to I.

I. Waste Classification

High Degree of Hazard: _____ Go to J.
Low Degree of Hazard: _____
Not a Hazardous Waste: _____ Go to K.

Figure 10 (Continued)

J. The Hazardous Waste Treatment/Disposal Method selected is:

I_{BA} ___
I_{R} ___
L_{BA} ___
L_{NG} ___
L_{R} ___
L_{F} ___

Basis for Selection:

Go to K.

K. Handling Properties

	Waste		Hazardous Constituent	
	Result from List or Testing	Hazard Value	Result from List or Testing	Hazard Value
Ignitability				
Corrosivity				
Reactivity				

Discussion

This is perhaps the most complete hazard ranking system suggested to the Agency. The fact that the system is extremely complex indicates the complexity of making a degree of hazard determination based on both intrinsic properties and exposure and then relating those factors to waste management. The Agency is not suggesting that this system is sufficient in those regards, but it is a good illustration of the minimum complexity such a system would involve. EPA does not believe that a system of this complexity could feasibly be applied in a national regulation. However, this concept could have applicability as a part of the permitting process, and will be further considered by the Agency in developing guidance for permit writers to support the Phase II regulations. However, this system, particularly from the standpoint of a national regulation, does have several shortcomings.

(1) It requires extensive waste testing, which would significantly increase the economic impact of the regulations.

(2) The basis and justification for the hazard values assigned to various waste characteristics is not stated, and would be difficult to justify.

(3) The type of management requirements associated with various hazard levels is specifically stated, but the justification for the different management levels is not provided, i.e., it is not clear why any given management scenario provides the "correct" level of

protection of health and the environment for wastes in the hazard level associated with it.

4. Comment

One commenter suggested that at least three separate classifications of hazardous wastes should be defined. In their initial comments (i.e., those submitted during the 90-day comment period on the proposed regulations) the commenter provided only a very general and broad description of the three classes. However, in response to the Agency's request for additional information on the commenters degree of hazard system, the commenter provided the following suggestion:

Class I This class would consist of those wastes which are life threatening because virtually any human exposure to such wastes is considered unacceptable. Because such wastes pose a grave, constant and continuing hazard to human health and the environment during all phases of their handling and disposal, such wastes require special care in storage, handling treatment and disposal, with the means of disposal designed to provide indefinite containment and monitoring.

(a) Class I waste. (1) Definition - A solid waste is a class I hazardous waste if a representative sample of the waste meets the characteristics specified in paragraphs (i) or (ii) below or if it is listed in paragraph (iii) below.

(i) Toxicity. The waste contains any concentration greater than [0.10% (100 ppm)] of any material with an oral mammalian LD_{50} of [5 mg/kg or less] or an aquatic (fish) LC_{50} of [1.0 mg/l or less].

(ii) Reactivity. The waste displays any of the following characteristics:

(A) Is readily capable of detonation or explosive decomposition or reaction at normal temperatures and pressures, or

(B) Is a forbidden explosive as defined in 49 CFR 173.51, a Class A explosive as defined in 49 CFR 173.53, or a Class B explosive as defined in 49 CFR 173.58.

(iii) The following wastes are classified as Class I hazardous wastes, unless it can be demonstrated, pursuant to the procedures under §250.15, that the Administrator's basis for listing the waste does not meet the criteria for listing under §250.12(b).

(2) Identification Method. Oral-rat LD_{50} protocol, based upon the NIOSH Registry of Toxic Effects of Chemical Substances (1976).

Class II This class would consist of those wastes which pose a serious hazard to human health and the environment during some phase of their storage, handling, treatment or disposal, but which do not present the grave, constant and continuing hazard posed by Class I wastes.

Class II wastes. (1) Definition - A solid waste is a Class II hazardous waste if a representative sample of the waste meets any of the characteristics specified in paragraphs (i) through (iv) below.

(i) Ignitable waste. The waste displays any of the following characteristics:

(A) Is a liquid and has a closed cup flash point less than 37.8°C (100°F) determined by the method cited below or an equivalent method, and is defined as a flammable on the wick test and combustible in accordance with the British Combustibility Test, (both of which are currently under development by the ASTM Coordinating Committee on flash point and related properties), or

(B) Is not a liquid but is liable to ignite through friction, absorption of moisture, spontaneous chemical changes, retained heat from manufacturing or processing or other conditions, and when ignited burns so vigorously and persistently as to create a hazard during its management, or

(C) Is a flammable compressed gas as defined in 49 C.F.R. 173.300(b), or is an oxidizer as defined in 49 C.F.R. 173.51.

(ii) Corrosive waste. The waste displays any of the following characteristics:

(A) Is aqueous or a suspension and has a pH less than or equal to 2 or greater than or equal to 13 as determined by the method cited below or an equivalent method, or

(B) corrodes steel (SAE 1020) at a rate greater than 0.250 inches per year at a test temperature of 130°F as determiend by the method cited below or an equivalent method.

(iii) Reactive waste. The waste displays any of the following characteristics:

(A) Undergoes violent chemical change or forms toxic or explosive gases, vapors or fumes when exposed to catalysts, finely divided metal or common physical or chemical agents, including organic matter, or

(B) Is capable of detonation or explosive reaction but requires a strong initiating source or must be heated under confinement before initiation can take place, or

(C) Reacts violently with water or forms toxic or explosive gases, vapors or fumes when mixed with water.

(iv) Toxic waste. If, according to the methods specified in paragraph (2), the extract obtained from applying the Water Extraction Procedure (WEP) cited below to a representative sample of the waste yields a concentration of a substance which exceeds 100 times the EPA National Interim Primary Drinking Water Standard for such substance.

(2) Identification methods.

(i) Ignitable waste. (As in proposed regulations.)

(ii) Corrosive waste. (As in proposed regulations, plus addition of a method for testing a suspension.)

(iii) Reactive waste. (As in proposed regulations.)

(iv) Toxic waste. Water Extraction Procedure.

Class III This class consists of those wastes which are deemed to be hazardous to human health or the environment only if the wastes are not handled in a prescribed, controlled manner. Thus, the requirements for management of Class III wastes will generally only ensure that particular or certain avoidable circumstances are prevented which would otherwise result in the inclusion of such materials in the Class II category.

Class III wastes. (1) Definition - A solid waste is a class III hazardous waste if a representative sample of the waste meets any of the criteria specified in paragraphs (i) through (iv) below.

(i) Ignitable waste. The waste displays any of the following characteristics:

(A) Is a liquid and has a closed cup flash point less than 93°C (200°F) determined by the method cited below or an equivalent method, and is defined as flammable on the wick test and combustible in accordance with the British Combustibility Test, both of which are currently under development by the ASTM Coordinating Committee on flash point and related properties and interaction with governmental agencies, or

(B) Is not a liquid but ignites when exposed to an external ignition source, and when ignited burns so vigorously and persistently as to create a hazard during its management.

(ii) Corrosive waste. The waste is aqueous or a suspension and has a pH less than or equal to 3 or greater than or equal to 12 as determined by the method cited below or an equivalent method.

(iii) Reactive waste. The waste forms toxic or explosive gases, vapors or fumes only under conditions of extreme heating in a confined space or when exposed to moderately acidic or basic conditions.

(iv) Toxic waste. If, according to the methods specified in paragraph (2), the extract obtained from applying the Acid Extraction Procedure (AEP) cited below to a representative sample of the waste yields a concentration of a substance which does not exceed 100 times the EPA National Interim Primary Drinking Water Standard for such substance.

(2) Identification Method. As proposed above for Class II wastes, but substituting an acid extraction procedure for the water extraction procedure.

In addition to the above suggested scheme, the commenter recommended the following small quantity exemptions for the three classes:

Class I - 10 kg/mo
Class II - 1000 kg/mo
Class III - 10,000 kg/mo

Discussion

This commenter has provided a relatively comprehensive system for classifying waste according to hazard level, and has defined the criteria for each class. However, the proposal is still deficient in a number of ways:

(1) The justification and rationale are not clear for the ranking of the hazardous characteristics into each of the hazard levels, or for the limits within characte-

ristics chosen to define the wastes belonging in each class. This system ranks both characteristics and limits within characteristics differently than other systems suggested by commenters. This ranking appears no more or no less rational than others, but none have been justified.

(2) The classification is incomplete. For example: wastes with toxicity greater than an $LD_{50} < 5$ mg/kg are not included, and therefore, most organic toxics are not included; there is no mention of carcinogenic or mutagenic wastes; the properties of persistence and bioaccumulativity are not mentioned.

(3) The references to management requirements for each class are vague. The substantive differences in requirements are not discussed. For example, what is meant by "requirements that ensure that certain avoidable circumstances are prevented?"

(4) There is no justification for the quantity exclusion limits suggested. Are these limits below which the waste is not hazardous? If so, how were they determined? If not, what do they represent? Why is the level for Class II 100 times the level of Class I?

(5) As discussed relative to several other systems, this system is based on intrinsic hazard only and does not consider exposure in defining hazard levels.

5. Comment

One commenter suggested a two-tier degree of hazard system along the following lines:

Primary Hazardous Waste

Toxic Waste - (1) Waste that has an acute toxicity criteria with an LD_{50} value equal to, or less than 100 mg/kg or an LC_{50} value equal to, or less than, 20 ppm.

(2) Waste characterized by significant persistence, bioaccumulation, carcinogenicity, mutagenicity or teratogenicity.

(3) §250.13(d) at 100 times the NIPDWS.

Reactive waste - §250.13(c)(1)(i), (1)(iii) and (1)(iv).

Infectious waste - Wastes included in Class A as classified by the Joint Commission on Accrediting Hospitals or as Class 3, 4 or 5 as defined by CDC unless adequate provisions are taken to treat waste (Appendix VII - 43 FR 58964).

Special Waste

Toxic Waste - (1) Waste that has an acute toxicity criteria with an LD_{50} value between 100 mg/kg and 2,500 mg/kg or an LC_{50} value between 20 ppm and 500 ppm.

(2) §250.13(d) between 10 and 100 times the NIPDWS.

Ignitable Waste - Waste that has the characteristics of §250.13(a)(1)(i) and (1)(ii) or an open cup flash point equal to, or less than 100°F.

Corrosive Waste - Waste that has the characteristic of §250.13(b)(1)(i).

Reactive Waste - Waste that has the characteristic of §250.13(c)(1)(ii).

Infectious Waste - Wastes included in Class B as classified by the Joint Commission on Accrediting Hospitals or as Class 2 as defined by CDC.

Discussion

This proposal has the benefit of greater simplicity than many others because it has only two levels of hazard. It is relatively comprehensive in terms of characteristics and properties included in ranking. However, it has the following shortcomings.

(1) The commenter has not provided justification or rationale for characteristics included in the various hazard levels or for the limits within characteristics chosen to define those levels.

(2) There is no suggestion of how management requirements would differ for the two tiers, or how the hazard ranking would otherwise be used.

(3) The system is based on intrinsic hazard only, and does not consider exposure in assigning hazard levels.

6. Comment

One commenter suggested that the Agency establish two levels of hazard, wherein the most severe hazards would require disposal at duly licensed, bonded and protected hazardous waste sites meeting full requirements under RCRA Section 3004. Wastes of the lower level might be disposed at regulated facilities which would not be so heaviliy restricted and financed. More specifically, the commenter suggested the following degree of hazard approach as an example:

ORAL TOXICITY

Degree	Condition
	° Oral LD_{50} (RAT) less than 100 mg/kg,
	° Concentration greater than 0.96 X LD_{50}
	or
HIGH	° Oral LD_{50} (RAT) greater than 100 mg/kg and less than 5000 mg/kg,
	° Ratio of concentration to LD_{50} greater than 20
LOW	° Oral LD_{50} (RAT) greater than 100 mg/kg and less than 5000 mg/kg,
	° Concentration greater than 0.96 X LD_{50},
	° Ratio of concentration to LD_{50} less than 20

Discussion

The Agency sees the following shortcomings in this proposal:

(1) The commenter provided no technical rationale or justification for the toxicity limits defining the two levels. (e.g. Why is an $LD_{50} < 100$ mg/kg established for high hazard wastes).

(2) The scheme appears to only address "toxic wastes" and ignores ignitable, corrosive, reactive, radioactive and infectious wastes.

(3) The differences in the management requirements suggested are referenced only vaguely, and appear to relate only to land disposal.

(4) The proposal considers intrinsic hazard only in assigning hazard levels.

7. Comment

One commenter suggested that at least three separate classifications of hazardous waste should be defined - "extremely hazardous", "hazardous" and "marginally hazardous" and that the Subtitle C program should be implemented in phases commencing with the extremely hazardous category. The commenter further suggested that the Agency use a dual extraction step to develop the three-tier system. As an example they provided the following system:

Tier I - (secure landfill) - Distilled (deionized water) as the extractant - concentrations of a contaminant exceeds the values prescribed.

Tier II - (industrial landfill) - Distilled (deionized water) as the extractant - concentrations of a contaminant not to exceed the values prescribed.

Tier III - (municipal landfill) - Distilled (deionized water) and 0.5 N acetic acid used as the extractants - concentrations of a contaminant not to exceed the values prescribed.

Discussion

The Agency sees the following shortcomings in this proposal:

(1) There are no specific limits suggested for defining Tiers I, II, and III.

(2) The scheme appears to address only "toxic waste" and completely ignores ignitable, corrosive, reactive,

radioactive and infectious wastes.

(3) The system considers land disposal only and does not specify how the technical requirements of the three different types of landfills would differ.

(4) The system considers intrinsic hazard only.

8. Comment

One commenter suggested that the Agency develop a three class system along the conceptual lines described below:

		Exclusion Quantity kg/month	(lbs/month)
Class I	Those wastes which present a serious continuing and persistent hazard to health or to the environment and which, therefore, require special care in storage, handling, and disposal including, of course, secure landfill disposal area. This would include, for example, recognized carcinogens which have been assessed to pose unreasonable human risk at exposure levels and in situations relevant to waste disposal, including biodegradability. This also includes highly toxic materials and highly reactive or highly corrosive wastes.	10	(22)
Class II	Those wastes which present a moderate hazard to health or to the environment, but which can be handled (except for disposal) in a normal manner using standard containers and equipment, and do not require the same degree of special care required by Class I wastes. This would include	100	(220)

		Exclusion Quantity kg/month (lbs/month)
	non-reactive powdered or liquid toxic materials of a persistent nature that are not recognized mutagens, but have a moderate degree of aquatic or human toxicity. Except for disposal in secure landfill areas, these wastes would not be subject to the more restrictive controls applicable to Class I waste.	
Class III -	Those wastes which present no hazard to health or the environment when handled in a prescribed, controlled manner. This would include certain flammable materials and reactive materials which require an initiating source (such as ignition) or a combination of other materials or elements not normally encountered in the environment in order to create a hazard. This would also include special wastes where the degree of risk is sufficiently low that adequate protection is provided by technology essentially equivalent to normal sanitary landfills, but where additional management is required. These wastes would not be subject to the restrictive controls applicable to Class I and Class II wastes, but would be subject to certain occupational health and safety regulations for handling and disposal.	1,000 (2,200)

Discussion

The Agency sees the following shortcomings in this proposal:

a. The scheme suggested is too vague to define the various classes (e.g. for Class I - what is a highly toxic, reactive or corrosive waste; Class II - what does moderately hazardous mean, how does the commenter define persistent, etc.). There are no limits suggested and/or test methods to identify these wastes.

b. The commenter provides no justification for the quantity exemption limits (i.e. why should 10 times the amount of Class II waste be exempt compared to Class I wastes?);

The Agency requested additional information from this commenter on their degree of hazard system. In response they indicated their support for the schemes submitted by the Forest Industry Resource and Environment Program and the Chemical Manufacturers Association.

9. Comment

A number of commenters suggested a degree of hazard system based upon multiple extractions. The commenters suggestions varied somewhat. For example some commenters suggested that the EP be modified to have multiple eluents, while other commenters suggested that the ASTM extraction tests (Methods A and B) be used. Under this system, two classes of hazardous wastes would be set-up:

Class I - Fail distilled (deionized water) extraction test - exceed values prescribed (i.e., 10 times Interim Primary Drinking Water Standards).

Class II - Pass distilled (deionized water) extraction test - fail acid extraction test - exceed values prescribed (i.e., 10 times Interim Primary Drinking Water Standards.

Response to Comment No. 9

The Agency sees the following shortcomings in this proposal:

(1) It addresses only "toxic wastes" and completely ignores ignitable, corrosive, reactive, radioactive and infectious wastes.

(2) Different management standards for the different hazard levels were not provided.

(3) It is based on intrinsic hazard only.

10. Comment

One commenter suggested that the regulations be revised to include a five-year phased implementation plan. In this manner, all highly hazardous wastes, which may cause an acute impact on health and the environment, are controlled with available resources first. The scope of implementation should then be gradually increased beginning in Summer 1980, reaching full scale in five years. The specific degree of hazard system suggested is as follows:

Class A - Primary Hazardous Waste Characteristics and Listing - Applicable upon promulgation. This class includes acutely hazardous wastes which are ignitable or reactive. Toxic wastes identified by the Extraction Procedure (EP) are not included in this class.

Class B - Secondary Hazardous Waste Characteristics and Listing - Applicable two years after promulgation. This class includes corrosive wastes which are not ignitable or reactive.

Class C - Tertiary Hazardous Waste Characteristics and Listing - Applicable four years after promulgation. This class includes wastes which are determined hazardous either by chemical testing of the EP leachate or by biological testing using the leachate. The commenter claimed (the four year period prior to implementation of this phase will allow adequate time to refine the EP, since the validity of the proposed EP, in the commenter's view, is a controversial issue among scientists).

Discussion

The Agency sees the following shortcomings in this proposal:

(1) Wastes of high organic toxicity and wastes which contain elevated levels of toxic heavy metals would not come under Subtitle C control until four years after initial promulgation (i.e. dioxin containing wastes would not be considered hazardous when the regulations are first promulgated).

(2) The scheme suggested is too vague to define the various classes (i.e., how does the commenter define ignitability, reactivity, corrosivity, and those wastes which are hazardous due to biological testing?). There are no limits suggested and/or test methods to identify these wastes in terms of the environmental protection provided.

(3) The commenter provides no technical rationale or justification other than phasing for the system suggested. For example, no differences in management are suggested.

11. Comment

One commenter suggested that the Agency develop a degree of hazard system along the conceptual lines described below:

Class 1 - Wastes which present a constant hazard to health or the environment and cannot be safely released into the environment in any significant quantities. These wastes would require extreme care in storage, handling and transporting, and should not be landfilled unless there is no other alternative.

Class 2 - Wastes which present a constant hazard to the health or environment, but do not require extreme care in storage, handling and transporting except to avoid spills which would result in endangerment of the suface and groundwater. These wastes can be landfilled in properly designated landfills.

Class 3 - Wastes which present no hazard to health or the environment when handled in a normal controlled manner during storage, handling and transporting. These wastes can be disposed of in landfills with less stringent design criteria than those for Class 1 and 2.

The commenter believes that EPA should place into Classes 2 and 3 only those small number of listed wastes for which information exists to properly make the classification. All other wastes which become hazardous due to the criteria would be in Class 1 unless the generator requested it to be placed in either Class 2 or 3. (The generator would be required to furnish sufficient information to justify the re-classification.)

Discussion

EPA sees the following shortcomings in this system:

(1) The scheme suggested is too vague to define the various classes (i.e., the Agency has no criteria to define: "present a constant hazard to health or the environment"; "cannot be safely released into the environment in any significant quantities"; "present a constant hazard to health or environment, but do not require extreme care in storage, handling, and transporting..."; and, "present no hazard to health or the environment when handled in a *controlled* manner during storage, handling, and transporting.") There are no limits suggested and/or test methods to define which wastes would belong in each class.

(2) The distinctions between the management methods suggested for each class are vague and insufficient. For example, what would constitute a "properly designated landfill" for Class II or "less stringent design criteria" for Class III.

EPA requested additional information from this commenter on their degree of hazard system. In response they indicated their support for a degree of hazard proposal submitted by the Forest Industry Resource and Environmental Program.

12. Comment

One commenter suggested that the Agency develop a degree of hazard system along the conceptual lines described below:

High Hazard Waste/Group I - Wastes which are known to present a severe, imminent danger to the environment and public health and which will require the utmost care during all stages of handling, storage and disposal are to be included in this group. An example of materials included in this group would be highly toxic pesticides which are persistent and bioaccumulative.

Hazard Waste/Group II - Wastes which pose a possible danger to the environment or public health if disposed of indiscriminately would be included in Group II. This group would include such wastes as used organic solvents, acids and mildly toxic wastes which are not persistent.

Marginally Hazardous/Group III - Wastes for which data indicate that potential hazards are relatively low would be included in Group III. These wastes would present only a minimal hazard to health and environment and could be handled with only a corresponding minimal amount of reporting and recordkeeping. Wastes included in this group would be certain industrial sludges and the waste EPA has proposed to handle as special wastes.

Response to Comment No. 12

The Agency finds the following shortcomings in this proposal:

(1) The scheme suggested is too vague to define the various classes (i.e. the Agency has no criteria to define:

"wastes which present a severe, imminent danger to the environment and public health and which will require the utmost care during all stages of handling...", "wastes which pose a possible danger to the environment or public health if disposed of..." and "wastes for which data indicate that potential hazards are relatively low..."). There are no limits suggested and/or test methods to define which wastes would belong in each class.

(2) The commenter provides no technical or rationale justification for the system suggested (i.e., why are highly toxic pesticides more of a concern than organic solvents which may be carcinogenci);

(3) There is no indication of the differences in management practices which would be applied to each class.

EPA requested additional information from the commenter on their degree of hazard approach. The commenter responded that it would be inappropriate for them to attempt to define in more detail the scope of each of the hazard classes. They went on to say that this task would be better accomplished by an industry/government task force relying in part upon technical information and advice from the chemical industry.

13. Comment

One commenter suggested that mixtures might be classified as to their degree of hazard according to the ingredient with the highest health, fire and/or reactivity hazard.

Discussion

The scheme suggested is extremely narrow in scope and very much lacking in justification. It leaves many basic questions unanswered. For example, it does not suggest how one decides which is is more hazardous - a toxic, ignitable, or reactive wastes. Similarly, the commenter does not define a toxic, ignitable or reactive waste. Basically, the commenter has presented a concept, but has given no suggestions of how it would be implemented.

14. Comment

One commenter suggested that the degree of care provided to a hazardous waste must be commensurate with its degree of hazard. More specifically, the commenter proposed that the following matrix rating system be utilized:

> Hazardous waste facilities be related on the basis of containment ability rather than require all such facilities to meet given design and operation requirements. In similar fashion, waste materials would be ranked on the basis of the particular hazards, and degre of hazard posed by the waste. Thus, for example, containment facilities having a low rating could accept only waste materials having a low hazard potential and requiring low containment.

Discussion

The approach suggested by the commenter is similar to the class of hazard distinctions the Agency has made in the Phase I regulations in that it focuses on waste properties (although it also includes degree of hazard). Thus, this proposal will be further considered before final promulgation of the Phase II §3004 technical standards which further deal with class of hazard distinctions. However, the commenter failed to provide any details of their system, e.g., how should the various classes of wastes be managed, and the management concept seems to focus on land disposal only.

15. Comment

One commenter suggested that the Agency develop a five-class system defined in terms of quantity of waste and concentration of waste, with the disposal site designed for each class of waste. More specifically, the five classes sugested are as follows:

> *Extremely hazardous wastes* - these wastes would, if not properly handled and controlled, represent a grave risk to human health or the environment through toxicity. These, in fact, would be life threatening in nature, and would require the most secure type of disposal site.
>
> *Hazardous wastes* - these would be of a toxicity range which could pose a substantial risk to health and/or the environment through improper handling, transfer or storage. However, they would not have the potential to cause an irreversible illness or death. These would have to be disposed of in such a manner that it would be extremely difficult for them to get into the environment where they could contact groundwater or biological systems. They would not require the extreme care and caution that would be exercised in handling and storage of extremely hazardous waste.

Dangerous waste - these wastes would be those which might possibly have toxic potential, but would be primarily the corrosive or flammable compounds that people occasionally have to dispose of. The concept here is that they are body threatening, rather than life threatening, and as such might require totally different type of handling and transport procedures. Additionally, these kinds of compounds might well have some potential uses and because of this would be subject to a different type of storage and handling which would make them available for use by others once delivered to a disposal site.

Special wastes - these wastes which have some degree of hazard to health or the environment, simply because of their quantity or quality, and as such can be rendered harmless by special handling, detoxification or neutralization procedures to make then nonhazardous. When these procedures are accomplished, these wastes would be disposed of in a normal, sanitary landfill or other nonhazardous waste disposal site.

Other wastes - these are wastes which may contain some small amount of some hazardous substance, but because of its concentration, make-up, or potential for hazard, it can be disposed of using due care in a normal, sanitary landfill.

Discussion

As is true of many of the degree of hazard proposals, this commenter has suggested a very appealing concept, but has provided few specifications for how it would work. The basic problems with this degree of hazard system are:

1) The scheme suggested is too vague, and does not provide a technical description of the various classes (i.e., what does the commenter mean by "...represent a *grave risk* to human health or the environment through toxicity...", "...pose a *substantial risk* to health and/or the environment through improper handling, transfer or storage...", "...that they are *body threatening*, rather than *life threatening*, and as such ...", etc.). There are no limits suggested and/or test methods to identify the different levels of human health impacts suggested, or the procedure for determining which wastes present each level of harm.

2) The commenter provides no technical justification or rationale for including (in general concept) only toxic wastes in the "extremely hazardous" and "hazardous" waste class (i.e., why are toxic wastes more of a concern than explosive wastes or highly flammable wastes?).

3) The differences in management requirements that would be associated with each hazard level are only referred to in general (conceptual) terms.

4) The hazard ranking is based on intrinsic hazard only, and does not include exposure considerations.

16. Comment

One commenter suggested that a two criteria test procedure be formulated to determine if a waste is hazardous based on its toxicity. These tests or extractive procedures (EP) would reflect that some wastes can be safely disposed in a properly constructed and maintained landfill or surface impoundment subject to State regulations (Subtitle D of RCRA) without the extra administrative and resource burdens imposed by the proposed regulations, and that other wastes must be disposed at an acceptable hazardous waste disposal facility. The two criteria are stated below:

1) The first test would indicate whether a waste is non-hazardous or potentially hazardous. The criteria for this test would employ an EP designed to model proper management of a landfill or surface impoundment by simulating the leaching action of rain and groundwater at such a site. If the extract from the procedure was below the levels set in the definition of toxic waste, the waste would be declared non-hazardous and subject to state or regional solid waste plans required under Subtitle D of RCRA, not Subtitle C; if the extract was above the toxic waste levels, the waste would be potentially hazardous and a second set of criteria would be tested.

2) The second test would indicate whether a waste is either hazardous or just potentially hazardous. A hazardous waste would have to be disposed in a permitted hazardous waste disposal facility according

to the RCRA Subtitle C regulations; potentially hazardous waste would either be disposed at an approved and permitted solid waste disposal facility or allowed to be transported to and used by a resource recovery facility without being subject to the Subtitle C regulations.

Discussion

This specific scheme has the following shortcomings:

a) hazard is defined in terms of proper management, rather than improper management as required by RCRA.

b) there are no limits suggested for defining the levels indicated in the definition of toxic wastes

c) the scheme appears to only address "toxic waste" and completely ignores ignitable, corrosive, reactive, radioactive and infectious wastes

d) the commenter did not provide any indication of the test to be used to determine whether a waste is hazardous or just potentially hazardous.

e) The proposal addresses only land disposal as a management method.

II. Comments on State Degree of Hazard Systems

EPA received comments from States and other commenters recommending Federal adoption of existing State degree of hazard programs. It should be recognized that the fact that a particular State may be successfully using such a program does not lessen the burden on EPA to justify its use on a national scale and to justify the technical basis for the program. In fact, even though a certain degree of hazard system (or any other program) may work in a particular State, it may be due to particular circumstances in that State that would not be applicable on a national level. On the other hand the experience with a program in a State is useful, within the limitations noted above, in evaluating its potential feasibility.

1. California Degree of Hazard System

In evaluating the definition of hazardous waste as defined by the California State Department of Health, the following waste classification scheme has been developed:

Extremely Hazardous Waste - Any hazardous waste or mixture of hazardous wastes which, if human exposure should occur, may likely result in death, disabling personal injury or serious illness cuased by the hazardous waste or mixture of hazardous wastes because of its quantity, concentration, or chemical characteristics.

Hazardous Waste - any waste or combination of wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may either:

- Cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness.
- Pose a substantial present or potential hazard to human health or environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

Under the California system, a list of hazardous substances and wastes and a set of criteria have been developed, however, it would appear that the criteria are used primarily by the generator to determine whether the components of the waste occur at high enough concentrations to consider the wastes hazardous.

The list of hazardous substances and wastes developed by California contains 216 extremely hazardous substances and 575 hazardous substances and 73 hazardous wastes. Anyone who generates a waste which is listed or which contains any of the listed substances will normally be classified as an extremely hazardous or hazardous waste (since the listed substances do not have appropriate concentrations associated with each substance, except in a few cases, we would conclude that the waste would be defined as hazardous if any of the hazardous substances were identified in the waste at any concentration). If none of the waste components appear on the list, the generator must still review the literature referenced in the regulations to determine if the components are hazardous or extremely hazardous. If the literature demonstrates that any of the waste's components' values fall numerically below the criteria, that waste must be considered hazardous unless testing is conducted to reclassify the waste.

The criteria which have been developed by the California State Department of Health for defining a hazardous or extremely hazardous waste are as follows:

	Hazardous	Extremely Hazardous
1. Toxicity		
- single oral LD_{50}	$\leq$ 2000 mg/kg	$\leq$50 mg/kg
- dermal LD_{50}	$\leq$ 1200 mg/kg	$\leq$ 200 mg/kg
- inhalation LC_{50}	$\leq$ 4000 ppm (gas or vapor)	$\leq$ 200 ppm (gas or vapor)
	$\leq$ 10,000 mg/m^3 (dust or mist)	$\leq$ 500 mg/m (dust or mist)
- 96-hour LC_{50}	$\leq$ 500 mg/l	------
- Carcinogen	Listed in the CAL-OSHA general industry safety orders Title 8, Calif. Adm. Code or suspected carcinogen, according to NIOSH	Listed in the CAL-OSHA general industry safety orders, Section 5209, Title 8, Calif. Adm. Code
- Material which, through experience of testing, has been shown to present a hazard to the public health or environment because:	Chronic toxicity, bioaccumulative properties, or persistence in the environment	Carcinogenicity, high chronic toxicity, bioaccumulative properites, or persistent in the environment

For the remaining characteristics, a single classification scheme (i.e., pass-fail system) has been developed, as shown below.

2. Flammable

   - is a liquid with a flash point $\leq$ 37.8°C (100°F).
   - is a gas for which a mixture of 13% or less with air forms a flammable mixture at atmospheric pressure or the flammable range with air at atmospheric pressure is wider than 12% regardless of the lower limits.

- is a solid which is likely to cause fires due to friction, retained heat from processing, or which can be ignited under normal temperature conditions and, when ignited, burns so vigorously and persistently as to create a serious threat to public and safety.
- is a gas, liquid, sludge or solid which ignites spontaneously in dry or moist air (a pyrophoric material), at or below 54.3°C (130°F), or upon exposure to water.
- is a strong oxidizer.

3. Pressure-Generating and Reactive
    - is a Forbidden or Class A, B, or C explosive as defined in CFR, Title 49, Sections 173.51, 173.53, 173.88, and 173.1000 respectively.
    - is a water reactive material.
    - is in the NFPA reactivity category 2, 3 or 4.
4. Corrosive
    - pH $\leq$ 2 or $\geq$ 12, or its mixture with an equivalent weight of water produces a solution having a pH $\leq$ 2 or $\geq$ 12
    - causes visible destruction or irreversible alterations in skin tissue (ulceration or necrosis) when tested on the skins of albino rabbits using the patch-test technique described in CFR, Title 16, Section 1500.41

5. Irritant

- is a non-corrosive material which will induce a local inflammatory reaction using the patch test techniques described in CFR, Title 16, Section 1500.41, showing an empirical primary irritation score of 5 or more

6. Strong Sensitizer

- if it will cause on normal, living tissue, through an allergic or photodynamic process, a hypersensitivity which becomes evident on reapplication of the same waste or component

As indicated earlier, the criteria cited in the regulations appear to be included for the benefit of the generator if he believes his waste is not hazardous, even if a particular substance or waste is listed (i.e., the list serves as a guide for initial screening of the waste's components). Thus, if a generator questions the classification of his waste, data must then be submitted by the generator (i.e., calculated toxicity of the waste, whole animal studies, etc.) on the hazardousness of his waste. See Attachment 1 at the back of this appendix for details. After the data have been compiled and submitted to the California State Department of Health, a decision would be made as to whether to reclassify the waste.

Discussion

The degree of hazard system described above has worked relatively successfully in California. However, from the standpoint of a national regulation, EPA sees the following shortcomings of the system:

1) EPA is not aware of the technical justification for the ranking of the hazard classes or the limits within a characteristic for placing wastes in different hazard classes.

2) All hazardous wastes defined by California, both hazardous and extremely hazardous, are taken to the same disposal facilities (Class I). The only difference in management requirements is in administrative and handling requirements. The Agency does not believe such limited differences justify a complicated National degree of hazard system.

3) The definition of hazardous waste in California is different from that in the final EPA regulations. The hazardous wastes and substances used in listing hazardous wastes and structuring the degree of hazard system would not be applicable to EPA's hazardous waste definition without substantial modification.

2. Texas Degree of Hazard System

The definition of hazardous waste established by the Texas Department of Water Resources includes the following waste classification scheme which is based on the possible adverse impact that land disposal of certain types or classes of industrial solid waste might have:

Class I - Any industrial solid waste or mixture of wastes, which because of its concentration or physical or chemical characteristics is toxic, corrosive, flammable, a strong sensitizer or irritant, generates sudden pressure by decomposition, heat or other means and may pose a substantial present or potential danger to human health or the environment when improperly treated, stored, transported, disposed, or otherwise managed, including hazardous wastes identified by the administrator of the U.S. EPA pursuant to the Federal Solid Waste Disposal Act.

Class II - Any industrial solid waste or combination of industrial solid wastes which cannot be described as Class I or Class III as defined in the regulation.

Class III - Essentially inert and essentially insoluble industrial solid waste, usually including materials such as rock, brick, glass, dirt, certain plastics, rubber, etc. that are not readily decomposable.

In the Texas classification system, both a list of hazardous substances and a set of criteria have been developed. However, it would appear from the regulations that the criteria will be used primarily by the generator to reclassify his waste rather than get on the list.

The list of hazardous substances developed by Texas contains approximately 300 toxic substances, 100 corrosives or irritants, 250 flammable materials, 10 strong sensitizers and 40 pressure generating materials. Seventy wastes are included on the list. Anyone who generates a waste which contains any of the listed substances will normally be classified as Class I wastes. Since the listed substances in most cases do not have appropriate concentrations associated with each substance, EPA would conclude that a waste would be defined as hazardous if any of the listed substances were identified in the waste at any concentration. In reading the regulations and back-up material, it is not clear how the Texas Department of Water Resources developed the list of hazardous substances. The initial classification of the waste is made by the State on the readily available information with a conservation comparison to the criteria (i.e., a sample of the waste is submitted by the generator to the Texas Department of Water Resources for analysis).

The criteria which have been developed by the Texas Department of Water Resources in defining a hazardous waste are as follows:

	Class I	Class II	Class III
1. A calculated Hazard Index (see Attachment 2)	≤50	>50	> 50
2. A calculated or actually determined LD_{50} (by Finney's mathematical model for joint additive toxicity)	≤500 mg/kg	>500 mg/kg	>500 mg/kg
3. pH	<2.5 and >12	2.5 to 12	2.5 to 12
4. A corrosion rate on steel (SAE 1020) at a test temperature of 130°F as determined by NACE	>0.25 in/yr	<0.25 in/yr	<0.25 in/yr

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	Class I	Class II	Class III
5. A flash point determined by a Pensky-Martens Closed Cup Tester, using ASTM Std. D-93-73.	≤140°F	>140°F	>140°F

a) A waste may normally be reclassified to Class III if the waste could be reclassified Class II under the specific criteria limits outlined above and if the waste's liquid fraction, or the leachate obtained with distilled water from a dry solid waste, contains no concentration of any component in excess of the limits set by the U.S. EPA or the U.S. Public Health Service for that component in drinking water.

As indicated earlier, the criteria cited in the regulations appear to be included for the benefit of the genrators as reclassification criteria limits,i.e., to reclassify a waste from Class I to Class II or Class III. If the generator believes his waste is not hazardous (i.e., questions the initial classification of the waste), then data must be submitted on the criteria listed above. This includes:

1) A description of the process or processes from which the waste was generated.

2) A qualitative and quantitative analysis of the waste material. Such analyses should only be performed for those components that could reasonably be expected to be present in the waste due to the process or processes from the waste which was generated.

3) A qualitative and quantitative analysis of the liquid fraction of a waste or of the leachate.

4) Flammability of the liquid fraction of the waste and/or leachate.

5) Corrosivity of the liquid fraction of the waste and/or leachate.

6) Groundwater quality in the vicinity of the proposed disposal site (necessary only in the case of a Class I to Class III reclassification).

After the data listed above has been compiled, it would be compared to the specific criteria listed above to determine whether or not the waste may be reclassified.

Discussion

EPA sees the following shortcomings in the applicability of this system on a National basis:

1) Hazardous wastes, as defined by EPA all appear to be in one class in Texas. The purpose of Texas' degree of hazard system seems to be to distinguish between all hazardous wastes and two different classes of non-hazardous wastes. Thus, it does not appear to be applicable to determination of hazard levels among hazardous wastes.

2) In the Texas system, wastes are sent to the State for analysis and ranking. This is not feasible on a national level and is inconsistent with the approach to determination of hazard in the Subtitle C regulations.

3) EPA sees no technical justification in the use of the Hazard Index (HI) as a means of classifying wastes by

degree of hazard. It does not appear to include some characteristics, such as carcinogenicity, and it is based solely on a land disposal management scenario.

3. Washington Degree of Hazard System

The degree of hazard system for toxic wastes used by Washington State is based on a categorization scheme utilizing both aquatic toxicity (LC_{50}) and oral toxicity (LD_{50}). This basic scheme is as follows:

- Category A - any substance which in its pure form has an oral $LD_{50} < 5$ mg/kg, or any substance which in its pure form has an aquatic $LC_{50} < 1$ ppm.
- Category B - any substance which in its pure form has an oral LD_{50} of between 5 to 50 mg/kg, or any substance which in its pure form has an aquatic LC_{50} of between 1 and 10 ppm
- Category C - any substance which in its pure form has an oral LD_{50} of between 50 to 500 mg/kg, or any substance which in its pure form has an aquatic LC_{50} of between 10 to 100 ppm.
- Category D - any substance which in its pure form has an oral LD_{50} of between 500 mg/kg to 5 g/kg, or any substance which in its pure form has an aquatic LC_{50} of between 100 to 1000 ppm.

(Substances with different oral LD_{50}'s and LC_{50}'s will be classified in the more restrictive category.)

Based on this scheme, the Washington Department of Ecology has developed a two tier degree of hazard system for toxic wastes which includes extremely hazardous wastes and dangerous wastes. The extremely hazardous category was to be distinguished from the dangerous category because of its persistence, bioconcentration or genetic effects, and extreme toxicity, or because such quantities present an extreme hazard to man or wildlife. The specific criteria developed by the Department of Ecology are as follows:

a) Dangerous Wastes - A toxic dangerous waste is any waste greater than 50 kg (100 lb.) in weight and whose oral $LD_{50} < 5$ g/kg and whose aquatic $LC_{50} < 1000$ ppm and includes wastes with:

- greater than 0.01% Category A substances,
- greater than 0.1% Category B substances,
- greater than 1% Category C substances, or
- greater than 10% Category D substances.

In addition, wastes containing "etiologic agents" are toxic dangerous wastes.*

b) Extremely Hazardous Waste - An extremely hazardous waste is any waste which is:

° Hazardous due to Toxicity to Man and Wildlife - Any waste whose oral aquatic $LD_{50} < 50$ mg/kg or any waste whose aquatic $LC_{50} < 10$ ppm and includes wastes with:

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*Etiologic Agent - A viable microorganism or its toxin which causes, or may cause, human disease and is limited to those agents listed in 42 CFR 72.25(c) of the regulations of the Department of Health, Education and Welfare.

- greater than 1% of Category A substances and 500 g (1 lb.) of Category A substances,
- greater than 10% of Category B substances and 5 kg (10 lbs.) of Category B substances.

Any waste having category A, B and C substances shall be extremely hazardous when:

$$\% A + \frac{\%B}{10} \;\&\; \frac{\%C}{100} > 1\%$$

$$\text{grams A} + \frac{\text{grams B}}{10} \;\&\; \frac{\text{grams C}}{100} > 500 \text{ grams}$$

or

$$\text{pounds A} + \frac{\text{pounds B}}{10} \;\&\; \frac{\text{pounds C}}{100} > 1 \text{ lb.}$$

- Hazardous due to Quantity - Any waste whose oral $LD_{50} < 500$ mg/kg or any waste whose aquatic $LC_{50} < 100$ ppm when the quantity of such waste exceeds 50 kg (100 lbs.) and includes wastes with:
  - greater than 0.1% of Category A substances and when the waste contains more than 500 grams (1 lbs.) of Category A substances,
  - greater than 0.1% of Category B substances and when the waste contains more than 5 kg (10 lb) of Category C substances,

Any waste having category A, B and C substances shall be extremely hazardous when:

$$\% A + \frac{\% B}{10} \ \& \ \frac{\% C}{100} > 0.1\%$$

and

$$\text{grams A} \ \& \ \frac{\text{grams B}}{10} \ \& \ \frac{\text{grams C}}{100} > 500 \text{ grams}$$

$$\text{pounds A} \ \& \ \frac{\text{pounds B}}{10} \ \& \ \frac{\text{pounds C}}{100} > 1 \text{ lb.}$$

- Hazardous due to Persistence and Potential Hazard - any waste whose quantity is greater than 50 kg (100 lb) and whose concentraion of soluble heavy metals, halogenated hydrocarbons, or polycyclic, aromatic hydrocarbons exceeds 1%.

In addition to the above degree of hazard scheme for toxic wastes, the Department of Ecology has defined any waste greater than 50 kg (100 lb) in weight and which is corrosive, explosive, or flammable as physically dangerous wastes (i.e., no degree of hazard for these particular types of wastes). The Washington DOE has defined these terms as follows:

- Corrosive - Substances which, when mixed with an equal weight of water, yield a solution with a pH greater than 11 or less than 3
- Explosive - Substances capable of producing an explosion, which are not regulated by Chapter 296-52 WAC

(Washington Administrative Code) and which:

- Evolve heat or gas when heated to 40°C (100°F), or
- Evolve gas or heat when mixed with at 40°C (100°F), or
- Contain oxidizers, that is, substances that yield oxygen readily.

° Flammable - Substances which have a flash point at or below 40°C (100°F), as determined by the Tagliabue open cup tester, or other suitable method.

Discussion

This system is very similar to the system discussed under I(1) on page 2 of this Appendix. The comments there apply to this system as well. Additionally, it should be noted that current practice is to allow disposal of the "dangerous" class of wastes at Subtitle D (non-hazardous) waste facilities. Thus, the existing distinction in management practices would be contrary to the Subtitle C mandate. EPA understands that the State plans to initiate a separate permitting of sites for dangerous wastes in the future, but EPA does not have specific information on the technical differences in management practices which will be applicable to "extremely hazardous" and "dangerous" wastes.

4. Rhode Island Degree of Hazard System

The State of Rhode Island suggested that the Agency develop a degree of hazard system along the following lines:

Toxic Wastes

"Type 1A - Highly Toxic Waste" shall mean a waste which meets any of the following criteria:

a. The elutriate obtained by applying the Toxicant Extraction Procedure to a representative sample of the waste has any of the following properties as calculated using a recognized reference or where a recognized reference is not available as actually measured:

   1. An acute oral LD_{50} in the rat of 0 to 50 mg/kg of body weight determined when tested according to an approved protocol; or
   2. An acute LC_{50} in bluegills less than 0.1 ppm, when tested according to an approved protocol; or
   3. A quantitative analysis of the elutriate reveals that it contains a concentration of any substance for which an EPA Primary Drinking Water Standard has been established, equal to 10 times greater than that standard; or

b. An octanol/water partition coefficient (P) with log P greater than 3.0, according to an approved protocol; or

c. Contains as a component any chemical which has been designated as a carcinogen, a suspect carcinogen, mutagen, or teratogen in regulatory rule-making by any of the federal agencies (OSHA, EPA, FDA, or CPSC) at or above the levels designated by the agency; or

d. A quantitative analysis of a liquid waste reveals that it contains a substance which in the concentration present in the waste causes the waste to have a calculated rat LD_{50} of 50 mg/kg or less, as listed in an approved reference source.

"Type 1B - Moderately Toxic Waste" shall mean a waste which meets one of the following criteria:

a. The elutriate obtained by applying the Toxicant Extraction Procedure to a representative sample of the waste has any of the following properties as measured and/or calculated from an approved reference source.

    1. An acute oral LD_{50} in the rat greater than 50 but less than 500 mg/kg of body weight as determined when tested according to an approved protocol;

    2. An acute LC_{50} in bluegills of less than 1 ppm but greater than 0.1 ppm when tested according to an approved protocol;

b. A quantitative analysis of the waste reveals that it contains a substance which in the concentration present in waste causes the waste to have a calculated LD_{50} of greater than 50 mg/kg but less than 500 mg/kg of body weight as listed in an approved reference source.

"Type 1C - Slightly Toxic Waste" - shall mean a waste which means one of the following criteria:

a. The elutriate obtained by applying the Toxicant Extraction Procedure to a representative sample of the waste has any of the following properties as measured and/or calculated from an approved reference source:

1. An acute oral LD_{50} in the rat greater than 500 but less than 5,000 mg/kg body weight as determined when tested according to an approved protocol; or
2. An acute LC_{50} in bluegills greater than 1 ppm but less than 10 ppm when tested according to an approved protocol; or

b. A quantitative analysis of the waste reveals that it contains a substance which in the concentration present in the waste cuase the waste to have a calculated rat LD_{50} of greater than 500 but less than 5,000 mg/kg body weight as listed in an approved reference source.

Reactive Wastes

"Type 2A - Highly Reactive Waste" shall mean a waste which in itself is readily capable of initiating a detonation, or of explosive decomposition, reaction at normal temperatures and pressures, or which reacts explosively with water.

"Type 2B - Moderately Reactive Waste" shall mean a waste which in itself is capable of initiating a detonation or explosive reaction but requires a strong initiating source, or which must be heated under confinement before initiation, or which may react violently with water or oxidizable materials or which may form potentially explosive mixtures with water or oxidizable materials, or which may generate toxic fumes, such as cyanide and sulfide bearing wastes.

"Type 2C - Slightly Reactive Waste" shall mean a waste which in itself or when mixed with water is normally unstable or readily undergoes chemical change, but does not detonate or cause explosive reactions.

Flammable Wastes

"Type 3A - Highly Flammable Waste" shall mean:

a. Any liquid or gaseous material which is a liquid while under pressure, having a flash point below 73°F and a boiling point less than 100°F.

b. Any compressed gas or mixture for which a mixture of 13% or less (by volume) with air forms a flammable mixture, or the flammable range with air is wider than 12% regardles of the lower limit.

"Type 3B - Moderately Flammable Waste" shall mean:

a. A liquid having a flash point less than 73°F and a boiling point at or above 100°F, and those having a flash point at or above 73°F and a boiling point less than 100°F, or a liquid that ignites spontaneously in dry or moist air at or below 130°F.

b. Any compressed flammable gas or mixture having in the container an absolute pressure exceeding 40 psi 70°F, or regardless of the pressure at 70°F, having an absolute pressure exceeding 104 psi at 130°F, or any liquid flammable materials having a vapor pressure exceeding 40 psi absolute at 100°F.

"Type 3C - Slightly Flammable Waste" shall mean:

a. Liquids having a flash point above 100°F, but not exceeding 200°F.

b. Solids and semi-solids which readily give off flammable vapors below 100°F.

Corrosive Wastes

"Type 4 - Corrosive Waste" shall mean a waste which has any of the following properties:

a. Any aqueous waste having a pH less than or equal to 3.0, or greater than or equal to 12.0 as determined with a pH meter using the protocol specified in the "Manual or Methods for Chemical Analysis of Water and Wastes", EPA-625-16-74 003.

b. A non-aqueous waste, when mixed 50% by weight with distilled water, yields an aqueous portion with a pH less than or equal to 3.0, or greater than or equal to 12.0 as measured with a pH meter using the protocol specified in the "Manual of Methods for Chemical Analysis of Water and Wastes", EPA-625-16-74 003.

c. A gaseous material such that a 2 molar aqueous solution yields a pH less than or equal to 3.0, or greater than or equal to 12.0 as measured with a pH meter using the protocol specified in the "Manual of Methods for Chemical Analysis of Water and Wastes", EPA-625-16-74 003.

d. A corrosion rate greater than 0.250 inch per year on steel (SAE 1020) at a test temperature of 130°C as determined by NACE standarsd TM-01-69.

Infectious Wastes

"Type 5 - Infectious Waste" shall mean a substance that contains micro-organisms or helminths of CDC Classes 2 through 5

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of the Etiologic Agents listed in this regulation, if generated in quantities over 200 kg/month (440 pounds).

Radioactive Wastes

"Type 6 - Radioactive Waste" shall mean low level radioactive wastes including all solid, liquid and gaseous waste that exceed the maximum permissible concentrations for discharge to unrestricted areas as listed in Part A, Appendix A, Table II, columns 1 and 2 of 10 CFR 20, except that defined as high level solid, liquid or gaseous radioactive waste. High level solid, liquid and gaseous radioactive waste includes, but is not restricted to the solid, liquid and gaseous wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and concentrated wastes from subsequent extraction cycles, or equivalent, and concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing of irradiated reactor fuel.

Irritating Wastes

"Type 7A - Highly Irritating Waste" shall mean a waste which has a mean Draize score of 6.6 to 8.0 when tested by an approved protocol; or which causes visible destruction or irreversible alterations in human skin tissue at the site of contact as determined by the method in 49 CFR 173.240, Appendix D.

"Type 7B - Moderately Irritating Waste" shall mean a waste which has a mean Draize score of 3.1 to 6.5 when tested by an approved protocol.

"Type 7C - Slightly Irritating Waste" shall mean a waste which has a mean Draize score of 1.6 to 3.0 when tested by an approved protocol.

Sensitizers

"Type 8 - Strong Sensitizers" shall mean a waste that produces an allergic sensitization in a substantial number of persons who come into contact with it, as determined by an appropriate test.

Other Hazardous Wastes

"Type 9 - Hazardous N.O.S." (Not Otherwise Specified) shall mean a waste which may not meet any of the criteria set forth in Types 1A-8, but which may still cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness or pose a substantial present or potential hazard to human health or the environment.

NOTE: "Waste LD_{50} (calculated)" shall mean the value arrived at by applying to either the elutriate obtained from the Toxicant Extraction Procedure or to a liquid waste the following equation:

$$\frac{1}{\text{Waste } LD_{50}} = \frac{C_1}{(LD_{50})_1} + \frac{C_2}{(LD_{50})_2} + \ldots + \frac{C_n}{(LD_{50})_n}$$

C_i = The concentration of a substance in a sample of the liquid waste or in the elutriate obtained by applying the Toxicant Extraction Procedure to other wastes.

$(LD_{50})_i$ = Oral, rat LD_{50} listed in a recognized source.

Discussion

The above degree of hazard system was one of the most comprehensive and detailed systems submitted to EPA during the comment period. However, as indicated earlier for other systems, the major problem was that no technical justification for the limits within characteristics and the ranking of characteristics used to define various degrees of hazard within a class were submitted to EPA. Furthermore, relating management standards to this complex hierarchy is, in the Agency's view, impractical.

In requesting additional information from the State on this degree of hazard system, especially with respect to the technical justification for the various levels established, the commenter responded as follows:

> "...The standards established in these rules and regulations (Rhode Island) are arrived at by this Department with significant input from a "Hazardous Waste Task Force" appointed by the Director of the Department and representing industrial, conservation and government interests in our community. Therefore, these regulations represent, for the most part, agreed upon level of standards which are acceptable to many interests .... The toxicity levels established for defining Types IA, IB and IC were originally proposed by the industrial representation on our task force and were based, I understand, from findings by this industry that these levels were, for the most part, acceptable to other federal agencies such as the Consumer Product Safety Commission..."

The commenter, however, failed to provide any actual technical justification as requested by EPA. This type of concensus rulemaking with industry cannot be carried out at the Federal level. To the best of EPA's knowledge, there are few management distinctions for the different hazard levels. "Extremely hazardous wastes" are required to be incinerated, but there are no other

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distinctions in management requirements. EPA believes that a primary purpose of such a complex hazard ranking is defeated with such a limited ranking system.

5. Maryland Degree of Hazard System

The Maryland Water Resources Administration has developed the following waste classification scheme:

Class I - included hazardous substances for which the Administration determines that sufficient documentation is available to indicate that improper disposal of these substances presents a grave risk to human health or the environment. The Administration may require pretreatment of these substances to lessen or eliminate their hazardous properties.

Class II - includes hazardous substances for which the Administration determines that information is available to indicate that improper disposal of the substances pose a major risk to human health or the environment.

Class III - includes hazardous substances which the Administration determines may pose a substantial threat to human health or the environment under certain conditions.

As is indicated, Maryland differentiates between the three classes of hazardous waste by the quantity of information available on the waste and the degree of risk to human health or the environment posed by the waste.

In addition to the narrative description provided, a list of specific chemicals and a set of general criteria for identifying designated hazardous substances are included in Maryland's regulations. The list of hazardous substances developed by the

State contains approximately 35 Class I hazardous substances, approximately 25 Class II hazardous substances, and an undetermined number of Class III hazardous substances (see Table 5). Also, a hazardous substance may be identified as a Class I, II, or III hazardous substance if:

- it is included in 40 CFR Part 116;
- it is designated as a toxic pollutant or hazardous substance under §307(a)(1) or §311(b)(2)(A) respectively of the Clean Water Act
- it is a chemical substance for which a maximum contaminant level has been established under the Safe Drinking Water Act;
- it is a chemical substance designated under §6 of the Federal Toxic Substances Control Act; or
- it is listed as a hazardous substance under Subtile C of the Resource Conservation and Recovery Act of 1976.

The criteria for identifying hazardous substances or for reclassifing the designation of a hazardous substance are as follows:

- toxic effects such as oncogenocity, teratogenicity, mutagenicity, and lethality;
- flammability or explosion potential;
- acid or caustic nature of the substance;
- reactive capability of the substance and nature of derivative products or by-products;
- bioconcentrative characteristics;
- persistence in the environment;

- mobility of the substance;
- synergistic and antagonistic effects; or
- other factors as deemed appropriate by the Administration.

As noted, the criteria do not have any specific limits associated with them, but will be used by the Maryland Water Resources Administration as a tool to assist them in identifying Class I, II, or III hazardous substances (i.e., classification of the waste is based on what the Administrator determines).

Discussion

The criteria for placing wastes into the three hazard categories are extremely vague in this system. Furthermore, one criterion used is the amount of information available on a waste, but it is unclear how this criterion is defined and applied. For example, there is no indication in either the regulations or back-up material submitted to EPA as to which substances in the following categories would be considered a Class I, II or III hazardous substance/waste: (1) 40 CFR Part 116, (2) as a toxic pollutant or hazardous substance under §307(a)(1) or §311(b)(2)(A) respectively of the Clean Water Act, (3) a chemical substance for which a maximum containment level has been established under the Safe Drinking Water Act, etc. For those wastes which the State has already listed it is not clear how the Maryland Water Resources Administration developed the list and classified the specific hazardous substances.

To EPA's knowledge the State does not have different management requirements for the various classes, other than additional reporting requirements for Class I. The major use of the class distinctions appears to be for assessing disposal fees. EPA can see no means of developing technically supportable management standards for the three hazard levels.

Attachment 1

California Procedures for Evaluating the Hazardous and Extremely Hazardous Properties of Wastes

In the evaluation of the hazardous and extremely hazardous properties of a waste, the following steps should be conducted in the indicated sequence within a given category (i.e., toxicity, flammability, etc.), except as noted. Which of these hazard categories are to be tested by the generator will depend on the category of hazard associated with the waste components. Thus, it may not be necessary to test for all six hazard categories. In addition, evaluation of a waste may be stopped when any step indicates the waste is hazardous or extremely hazardous.

Toxicity

Step 1: Determine if the waste contains a toxic substance or extremely toxic substance (see California hazardous and extremely hazardous waste list). If it does, it is designated toxic or extremely toxic unless steps 2 - 4 are carried out. If it does not, the waste is designated nontoxic or not extremely toxic.

Step 2: Determine if the waste (or its extract when applicable) contains a carcinogenic, persistent, or bioaccumulative substance in excess of the designated threshold level concentrations as indicated in the regulations. If it does, it is designated toxic or extremely toxic, and none of the following steps need to be carried out.

Steps 3 and 4 are carried out. (Step 4 may be done before Step 3.)

Step 3: Toxic Wastes - Determine if the waste is acutely toxic to fish as follows:

a) Determine if the waste has a 96-hour LC_{50} for fathead minnows (pimephales promelas) of 500 mg/l or less. If it does, the waste is designated toxic, and none of the following steps need to be carried out.

b) If the waste is a solid, sludge, tar, or slurry which is not entirely soluble in water at 500 mg/l and if Step 3a shows a a 96-hour $LC_{50} \geq$ 500 mg/l for a suspension of the waste in water, determine if the extract from the waste produces a 96-hour LC_{50} of 6 m/l or less for fathead minnows [is the ratio of the dry weight (water free) of the waste to the weight of an equivalent wet sample].

Extremely Toxic Wastes - Determine if the waste should be tested for extreme toxicity to mammals as follows:

a) Oral and Dermal Toxicity - Determine if the calculated oral and dermal LD_{50}'s are less than or equal to 50 mg/kg and 200 mg/kg respectively for wastes using the following equation.

$$\text{Calculated } LD_{50} = \frac{10}{\sum_{X=1}^{n} \frac{\% A_x}{LD_{50} A_x}}$$

where: $LD_{50}A_x$ = the oral or dermal LD_{50}'s of the pure toxic components; $\%A_x$ = present concentrations by weight of the toxic component in the waste.

(Only substances with reported oral LD_{50}'s $\leq$ 50 mg/kg or dermal LD_{50}'s $\leq$ 200 mg/kg need be considered in these calculations). If the calculated LD_{50}'s are numerically less than or equal to the above stated limits, the coresponding oral or dermal toxicity test in step 4 should be carried out; if it is not carried out; the waste is designated extremely toxic and no further evaluation is required. If the calculated LD_{50}'s are numerically greater than the acceptable criteria limits, Step 3b is carried out.

b) Inhalation Toxicity -

i. Vapor Hazards - If the waste contains one or more volatile, toxic substances with an inhalation LC_{50} $\leq$ 200 ppm and vapor pressure $\geq$ 1 mm Hg at 20°C, determine if the waste has the potential of generating a hazardous vapor mixture by calculating the vapor hazard index (VHI) as follows:

$$VHI = 6{,}600 \sum_{X=1}^{n} \frac{(P^{\circ}{}_{Ax})\ (\%A_{x}}{(M_{Ax})\ (T_{Ax})}$$

where: - $P°A_x$ = the vapor pressures 20-35°C of the pure volatile, toxic substances (expressed in units of mm of Hg) $\%A_x$,

-$\%A_x$ = present concentrations by weight of the toxic components in the waste,

-M_{Ax} = molecular weight of the toxic components,

-T_{Ax} = toxicities in ppm by volume in air

If the VHI is greater than or equal to one, Step 4 should be carried out. If Step 4 is not done, the waste is designated extremely toxic, and no further testing is required. If the VHI is less than one, Step 3(b)(kk) is carried out.

ii. Dust or mist hazard - If the waste consists of a liquid, dust, sludge*, slurry*, or friable solid, determine if the waste has a calculated inhalation LC_{50} less than or equal to 500 mg/m^3 using the following equation:

$$\text{Calculated } LC_{50}\ (mg/m^3) = \frac{10}{\displaystyle\sum_{x=1}^{n} \frac{\%Ax}{T_{Ax}}}$$

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*Applies to any slurry or sludge which, when dried, produces a friable solid.

where: -$\%A_x$ = percent concentrations by weight of the toxic components in the waste,

-TA_x = the inhalation toxicities expressed in mg of substance per cubic meter of air (LC_{50}, LC_{LO}, or 100 x TLV).

(NOTE: $mg/m^3 = \frac{\text{ppm X molecular weight}}{24.5}$

Only substances with reported LC_{50}'s $\leq$ 500 mg/m^3 need be considered in calculating an LC_{50} for the waste. If the calculated LC_{50} is less than or equal to 500 mg/m^3, Step 4 should be carried out. If Step 4 is not done, the waste is designated toxic, and no further evaluation is necessary.

Step 4: Toxic Wastes - Determine if the waste should be tested for toxicity to mammals using the equations listed in Step 3 of the extremely hazardous waste evaluation scheme. Only toxicity data on the toxic components of the waste shall be used. If the calculated toxicities are numerically less than any of the following limits, the appropriate tests in Step 5 should be carried out:

a) Oral: $LD_{50} \leq$ 2,000 mg/kg

b) Dermal: $LD_{50} \leq$ 1,200 mg/kg

c) Inhalation:

i) Vapor: VHI ≥ 1 (where only components with a vapor pressure ≥ 1 mm Hg at 20°C and $LC_{50} \leq 4{,}000$ ppm are used in the calculation).

ii) mist or dust: $LC_{50} \leq 10{,}000 \text{ mg/m}^3$

If steps 5 is not done, the waste is designated toxic. If all calculated LD_{50}'s and LC_{50}'s exceed these limits and the VHI is less than one and the waste passes Step 2, it is designated not toxic.

Extremely Toxic Wastes - Determine if the waste is extremely toxic to mammals. If any of the calculations in Step 3 indicate a potential extreme oral, dermal, or inhalation toxicity hazard from the waste, the corresponding animal toxicity testing shall be conducted. If the measured oral or dermal LD_{50} or inhalation LC_{50} is equal to or less than the extreme toxicity criteria, the waste is designated extremely toxic (extremely hazardous), and no further testing is required. If none of the measured toxicity parameters are less than or equal to their respective limits, the waste is not extremely toxic (not extremely hazardous).

Step 5: Toxic Wastes - Determine if the waste is acutely toxic to mammals. If any of the calculations in Step 4 indicated a potential oral, dermal, or inhalation hazard from the waste, the corresponding animal toxicity testing should be conducted. If the oral or dermal LD_{50} or inhalation LC_{50} equals or falls below the limits listed in the toxicity criteria, the waste is designated toxic, and no further testing is necessary. If none of the measured toxicity parameters are less than or equal to their respective lower limits and the waste has passed Step 2 and 3, the waste is designated non-toxic.

Flammability

Step 1: Determine if the waste contains a flammable substance. If it does, the waste is designated flammable unless the following step is carried out. If it does not, the waste is designated nonflammable.

Step 2: Determine if the waste itself conforms to any of the flammability criteria or definitions. If it does, it is designated flammable, and no further testing is necessary.

Pressure-Generating and Reactive

Step 1: Determine if the waste contains a pressure-generating or reactive substance. If it does, the waste is designated pressure-generating or reactive unless the following steps are carried out. If it does not, the waste is designated not pressure generating or not reactive.

Step 2: Determine if the waste conforms to any of the criteria or definitions. If it does, it is designated pressure-generating or reactive, and no further testing is necessary.

Corrosivity/Irritation

Step 1: Determine if the waste contains a corrosive or irritating substance. If it does, the waste is designated corrosive or irritant, respectively, unless the following steps are carried out. If it does not, the waste is designated noncorrosive and nonirritant.

Step 2: a) If the waste is an aqueous-based solution or mixture, determine if its pH is ≤ 2 or ≥ 12.

b) If the waste is not an aqueous-based solution or mixture, determine if a mixture of the waste in an equal weight of distilled water has a pH ≤ 2 or ≥ 12.

If either Tests 2a or 2b indicate a pH value ≤ 2 or ≥ 12 the waste is designated corrosive, and no further testing is necessary. If they do not, Test 3 is carried out.

Step 3: Conduct a test with the waste on the skins of albino rabbits using the patch-test technique described in CFR, Title 16, 1500.41. If the waste causes on skin tissue visible destruction or irreversible alterations (ulceration or necrosis), the waste is corrosive. If it does not, the waste is noncorrosive. If it causes a local flammatory skin reaction showing a empirical primary irritation score of 5 or more, the waste is an irritant. If it does not, the waste is a nonirritant.

Strong Sensitizer

Step 1: Determine if the waste contains a strong sensitizing substance. If it does, the waste is designated a strong sensitizer unless Step 2 is carried out. If it does not, the waste is designated nonsensitizing.

Step 2: Determine by testing if the waste conforms to the definition of a strong sensitizer. If it does, it is designated a strong sensitizer, and no further testing is required.

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Attachment 2

Texas Hazard Index

The Hazard Index (HI) of a material is a parameter developed by the Texas Department of Water Resources by which a material's possible environmental impact from improper disposal may be calculated based on the material's solubility and toxicity. The parameter HI may be defined by either of the following equations:

$$1) \quad HI = \frac{50}{\frac{Sw}{Tox_w}} \quad \text{or} \quad 2) \quad HI = \frac{50}{\sum_{1}^{N} \frac{Ci}{Tox_i}}$$

where S_w = the solubility of the waste in mg/l

Tox_w = the toxicity of the leachate or liquid fraction waste as Oral LD_{50} in mg/kg

C_i = the concentration of component i in a liquid fraction of the waste, or the leachate from a dry solid waste

Tox_i = the toxicity of component i expressed as Oral LD_{50}, Oral LDL_o or TDL_o

Oral LD_{50} = a calculated dose of a chemical substances which is expected to cause the death of 50% of an entire population of an experimental animal species, as determined by exposure to the substance by an oral route of a significant number of that population.

Oral LDL_o = the lowest dose of a substance other than the LD_{50} introduced by an oral route over any given period of time and reported to have caused death in man or the lowest single dose introduced orally in one or more divided portions and reported to have caused death in animals.

Oral TDL_o = the lowest dose of a substance, introduced by an oral route over any given period of time and reported to produce any toxic effect in man or to produce carcinogenic, teratogenic, mutagenic or neoplastigenic effects in humans or animals.

TABLE 5

LIST OF HAZARDOUS SUBSTANCES

Class I

Acrolein

Acetylaminofluorene

alpha-Naphthylamine

Aminodiphenyl

Auramine

beta-Naphthylamine

beta-Propiolactone

Benzidine

bis(Chloromethyl)Ether

Cadmium Salts

Chlornaphazine (bis(2-Chloroethyl)2-Naphthylamine)

Dichlorobenzidine

Dichlorodiphenyltrichloroethane (DDT)

Dimethylaminoczobenzene

Dioxins

Endrin

Ethyleneimine

Heptachlor

Heptachlor Epoxide

Kepone

Mercury Compounds

Methyl Chloromethyl Ether

Methylene-bis-Chloraniline

Class I (cont.)

Mirex

Mustard Gas (bi-Chloroethyl Sulphide)

Nickel Carbonyl

Nitrobiphenyl

Nitrosodimethylamine

Phosphorus (White)

Polybrominated Biphenyls (PBB)

Polychlorinated Biphenyls (PCB)

Tetrachlorodiphenylethane (TDE)

Tetraethyl Pyrophosphate

Vinyl Chloride Monomer

Class II

Aldrin

Antimycins

Arsenicals

Asbestos in Fibre Form

Chlordane

Chromates

Cyanides

Dimethyl Formamide

Disulfoton

Endosultan

Estrogeni Compounds

Fluoroacetic Acid, and its salts

Guthion

Class II (cont.)

Mercury (Metallic)

Mevinphos

Parathion

Pentachlorophenol

Phthalic Acid Esters

Picloram

Rotenone

Toxaphene

Trichloroethylene

Trichlorophenol

Tetraethyl Lead

Class III

(quantity limitations are on a monthly basis)

Acid and caustic wastes (unless otherwise classified) with a pH less than 4.0 or greater than 10.0 and in quantities greater than 50 gallons. chemical wastes referenced in Regulation .04D(1)-(3) (unless otherwise classified) in quantities greater than 50 gallons or 500 pounds. Combustion ash wastes (fly ash), in quantities greater than 2,000 pounds, excluding pozzolans as defined in Natural Resources Article, §7-464, that are used or stored for less than 5 years.

Pathological and medical wastes from hospitals, laboratories, and similar operations.

Pesticide wastes (unless otherwise classified) in concentrated quantities greater than 5 gallons or 50 pounds.

Attachment 3

Response to Additional Comments

Comment

With a degree of hazard system the opposition from the public to siting hazardous waste management facilities for the "less hazardous" wastes would be reduced because those wastes could be presented and labeled as not being "extremely hazardous".

Response:

EPA seriously questions that public opposition would be significantly reduced for less hazardous wastes, and could become heightened for more hazardous wastes to the point where siting of those facilities would be nearly impossible. Thus, the Agency does not believe that a degree of hazard system would significantly reduce siting problems overall.

Comment

Considerable precedent exists within the Agency for developing a degree of hazard system. Several commenters pointed out that *in* EPA's recently reproposed regulations under Section 311 of the Clean Water Act, a 5-tiered approach is used in setting "reportable quantities" of hazardous substances (44 FR 10271, February 16, 1979). As stated in the preamble, the commenters argued, the volume of each substance which is "reportable" was determined based upon EPA's estimate as to the amount which "may be harmful" when discharged or spilled. Commenters also pointed out that under TSCA the Agency has developed a list of up to 50 substances which by reason of their relative toxicty, persistance, and presence merit closer scrutiny.

Response:

EPA does not believe that the considerations of hazard or risk in the other referenced EPA programs are at all parallel to the issue of establishing degree of hazard of hazardous wastes. The other EPA programs referenced are under other (non-RCRA) mandates, deal with different types of regulations, and are concerned with different substances. Among other differences in the two situations mentioned, the regulation was dealing with relatively pure substances of generally known environmental effects. Furthermore, in neither case did the regulations actually develop a degree of hazard system as proposed by comments for the hazardous waste regulations.